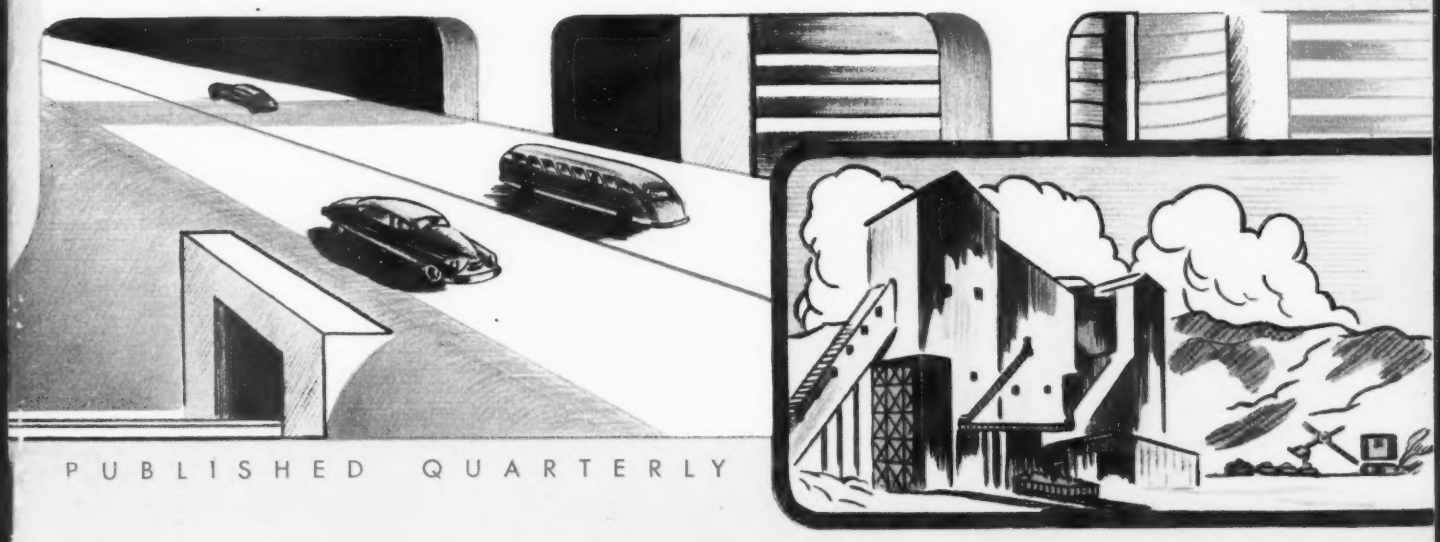
The CRUSHED STONE JOURNAL



PUBLISHED QUARTERLY

In This Issue

March 1951

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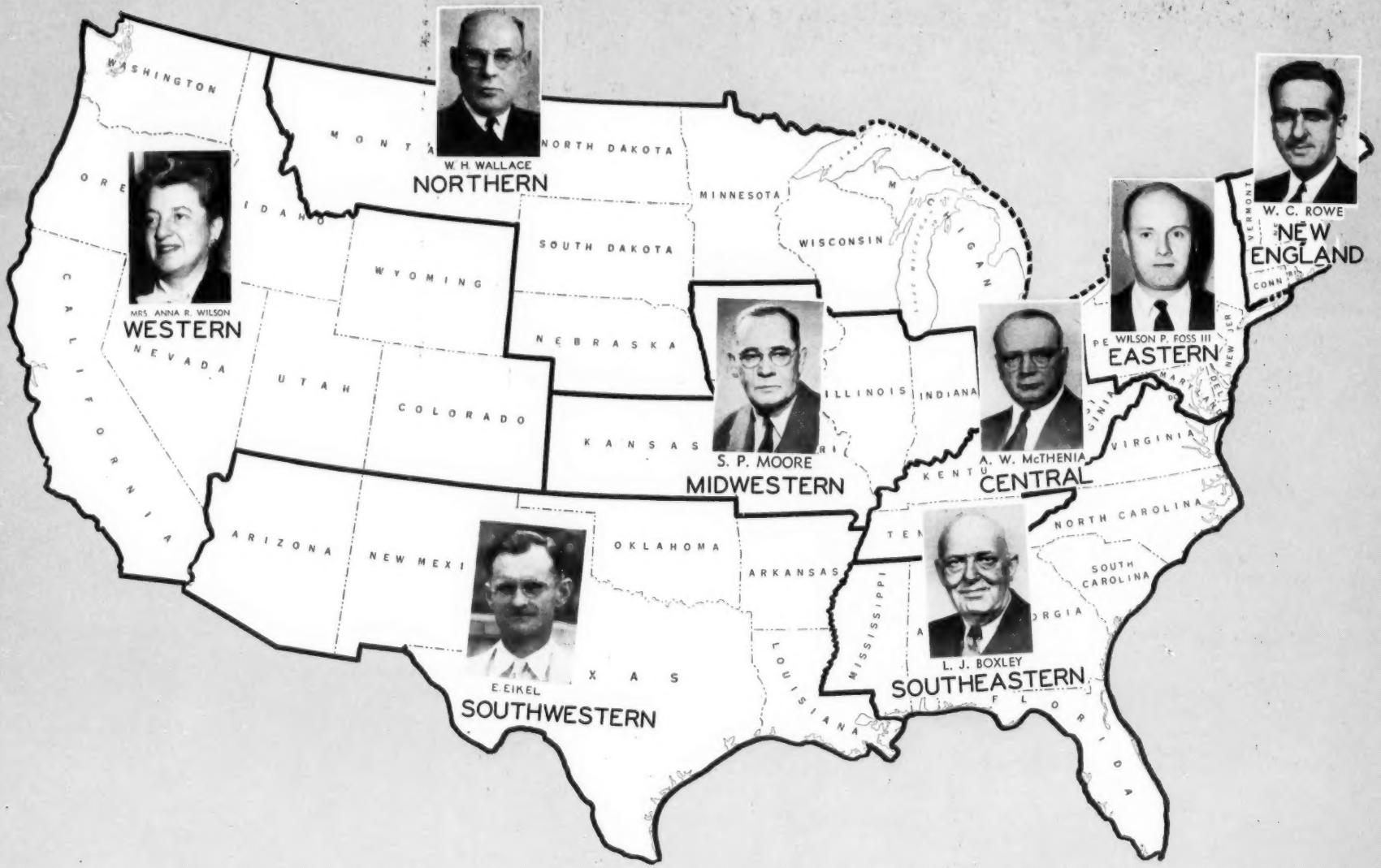
- Informative Talks Feature 6th ALI Convention
- The Practical Use of the Corps of Engineers' Tests on Bituminous Concrete
- NCSA Holds Fourth Short Course for Crushed Stone Salesmen
- Soil, Plants, Animals, and Men Need Lime
- A. T. Goldbeck Receives Distinguished Award

OFFICIAL PUBLICATION · NATIONAL CRUSHED STONE ASSOCIATION

MAP SHOWING REGIONS AND REGIONAL VICE PRESIDENTS FOR 1951
NATIONAL CRUSHED STONE ASSOCIATION



The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION

1415 Elliot Place, N. W.
Washington 7, D. C.

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J. E. GRAY, Field Engineer
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P. E. HEIM — W. S. WESTON, JR.
J. CRAIG McLANAHAN — W. F .WISE

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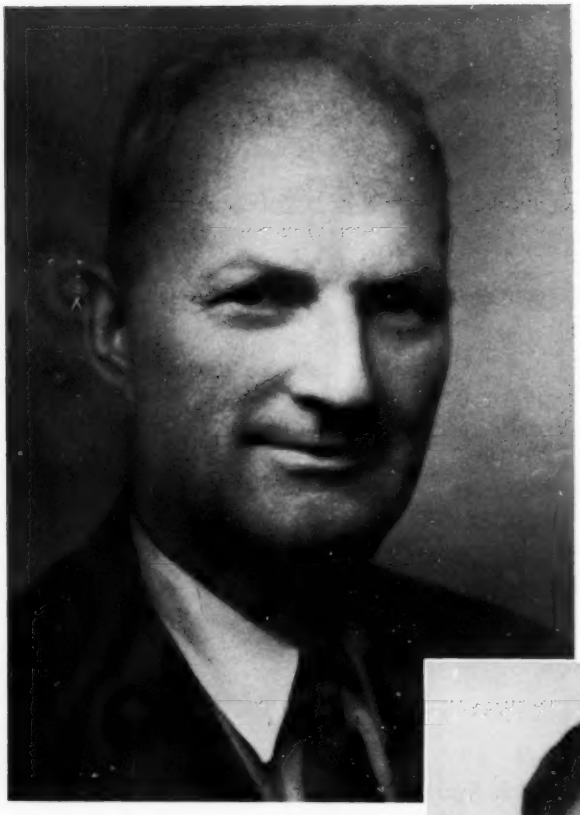


J. REID CALLANAN

President
Callanan Road Improvement Co.
South Bethlehem, N. Y.

●

Re-elected President

NATIONAL CRUSHED STONE ASSOCIATION

at its 34th Annual Convention

Cincinnati, Ohio

February 5-7, 1951

P. E. HEIM

Vice President
Carbon Limestone Co.
Lowellville, Ohio

●

Re-elected President

AGRICULTURAL LIMESTONE INSTITUTE

at its 6th Annual Convention

Cincinnati, Ohio

February 7-9, 1951

THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

Vol. XXVI No. 1 PUBLISHED QUARTERLY MARCH 1951

34th Annual Convention Attracts Large Attendance Despite Travel Difficulties

CRUSHED STONE producers will apparently not be denied the opportunity of foregathering once a year in annual convention to enjoy the many benefits and pleasures which result from participation in this traditionally outstanding event. Having in mind the extreme travel difficulties imposed upon many because of the switchmen's strike, it was truly an inspiring sight to see the gratifyingly large number present for the opening of the 34th Annual Convention of NCSA at the Netherland Plaza in Cincinnati, on Monday, February 5, 1951.

Combined registration figures for the two conventions (the 6th Annual Convention of the Agricultural Limestone Institute immediately followed the meeting of NCSA), totaled approximately 700, a figure far above the outlook at the close of the week before. Many members exercised real ingenuity in getting to the Convention at all, instances having come to our attention where changes in mode of transportation had to be made during the wee small hours in order to continue the trip to Cincinnati. Imagine our feelings upon arriving in Cincinnati, Friday before the Convention, to find that express shipments from Washington, containing programs and other very important convention supplies could not be located, and might very possibly be tied up in the traffic snarl resulting from the strike.

Carefully developed plans for special cars to the Convention had been arranged to bring members from New York State and from Pennsylvania, which at the last minute were cancelled. We understand that yeoman service in making emergency travel arrangements for many who had space on the special cars was rendered by W. H. Litteer of the General Crushed Stone Company, and our appreciation is due him for his helpful contribution to the success of the meeting.

The program which had been so carefully and thoughtfully planned by the Convention Arrangements Committee, under the Chairmanship of Otho M. Graves, was enthusiastically received and from the many comments heard during and after the Convention was obviously judged an outstanding success.

Many of the talks presented before the meeting have real practical value, are of lasting benefit, and will be made available either through the columns of the Journal, in mimeograph form, or will be printed as separate pamphlets.

For those members of the Association who found it impossible to attend the Convention, there is reviewed briefly in the following, certain events believed to be of especial interest.

New Election Procedure Put Into Effect

With this Annual Convention the new election procedure established in accord with revisions made in the By-Laws at the midyear meeting of the Board of Directors was put into effect. This required that the new Board, elected by mail ballot prior to the Convention, meet at the time of the Convention and elect the President, the Executive Committee, and other officers.

The meeting of the new Board was held on Sunday afternoon, prior to the opening of the Convention on Monday morning, with 36 members of the Board present.

J. REID CALLANAN
Callanan Road Improvement Co.
South Bethlehem, N. Y.
President
National Crushed Stone Association

P. E. HEIM
Carbon Limestone Co.
Lowellville, Ohio
President
Agricultural Limestone Institute

J. CRAIG MCLANAHAN
McLanahan & Stone Corp.
Hollidaysburg, Pa.
Chairman
Manufacturers Division

EXECUTIVE COMMITTEE

of the

NATIONAL CRUSHED STONE ASSOCIATION

for the year 1951

G. A. AUSTIN
Consolidated Quarries Corp.
Decatur, Ga.

WILSON P. FOSS, III
New York Trap Rock Corp.
New York, N. Y.

S. P. MOORE
Concrete Materials and Construction Co.
Cedar Rapids, Iowa

RUSSELL RAREY
Marble Cliff Quarries Co., Columbus, Ohio

W. F. WISE
Southwest Stone Co.
Dallas, Texas

W. S. WESTON, JR.
Weston & Brooker Co.
Columbia, S. C.

NEWLY ELECTED TO THE NCSA BOARD

J. V. OWENS
Eastern Rock Products, Inc.
Utica, N. Y.

W. M. PALMER
Tyrone Rock Products Co.,
Ocala, Fla.

W. T. RAGLAND, JR.
Superior Stone Co.,
Raleigh, N. C.

WARREN C. ROWE
Rowe Contracting Co.,
Malden, Mass.

Shortly after the opening of the meeting the Board was shocked and deeply distressed when Otho M. Graves stated certain circumstances had arisen which made it no longer possible for him to serve on the Board of Directors. When pressed for an explanation he said the reasons were personal, that no helpful purpose would be served by divulging them and would the Board just please accept his resignation without discussion. The Board was unanimous in its belief that there must be some way open to retain the services of Mr. Graves on the Board and, therefore, deferred action until the midyear meeting of the Board.

Subsequently, when elected by secret ballot to the Executive Committee, Mr. Graves said he could not serve and when the results of the elections were announced to the Convention at the opening session on Monday morning, he again stated that he could not be considered a member of the Board or of the Executive Committee.

Since the Convention there have been consultations with Mr. Graves which have made it clear that his decision should be honored and, therefore, he is not included as a member of the Board or of the Executive Committee. It is hoped that arrangements can be made at the midyear meeting of the Board which will enable Mr. Graves to continue his services to the Association.

JAMES SAVAGE
Buffalo Crushed Stone
Corp., Buffalo, N. Y.
Re-elected Treasurer

J. Reid Callanan Re-Elected President

In recognition of his capable and sympathetic administration of Association affairs during the past year, J. Reid Callanan was re-elected President by acclamation.

Executive Committee and Officers Elected

Under the new election procedure the seven members of the Executive Committee representing the active membership are elected by the Board by secret ballot.

There were 23 candidates placed in nomination and the 7 receiving the highest number of votes, named in alphabetical order are:

G. A. Austin, Consolidated Quarries Corp., Decatur, Ga
Wilson P. Foss. III, New York Trap Rock Corp., New York, N. Y.
Otho M. Graves, General Crushed Stone Co., Easton, Pa.
S. P. Moore, Concrete Materials and Construction Co., Cedar Rapids, Iowa
Russell Rarey, Marble Cliff Quarries Co., Columbus, Ohio
W. S. Weston, Jr., Weston and Brooker Co., Columbia, S. C.
W. F. Wise, Southwest Stone Co., Dallas, Texas

Meeting of Newly Elected NCSA Board of Directors

J. CRAIG MCLANAHAN
McLanahan & Stone Corp.
Chairman
Manufacturers Division

IRWIN F. DEISTER
Deister Machine Co.
Fort Wayne, Ind.

COTTRELL FARRELL
Easton Car and Construction Co.
Easton, Pa.

EXECUTIVE COMMITTEE

of the

MANUFACTURERS DIVISION

National Crushed Stone Association
for the year 1951

W. W. KING
W. S. Tyler Co.
Cleveland, Ohio

B. R. MALONEY
E. I. du Pont
de Nemours & Co.
New York, N. Y.

J. REID CALLANAN
President, NCSA
Callanan Road Improvement Co.
South Bethlehem, N. Y.

NEWLY ELECTED TO THE MANUFACTURERS DIVISION BOARD

C. R. DODGE
Northwest Engineering Co., Chicago, Ill.

H. W. NEWTON
Barber-Greene Co.
Aurora, Ill.

L. A. RHODES
Jeffrey Manufacturing Co., Columbus, Ohio

The Board in discharging its further responsibility of selecting officers for the ensuing year, unanimously re-elected the following:

Treasurer	James Savage
Secretary	J. R. Boyd
Engineering Director	A. T. Goldbeck
Administrative Director	J. R. Boyd
Field Engineer	J. E. Gray

Russell Rarey was also re-elected to represent the NCSA on the Board of Directors and on the Executive Committee of the Agricultural Limestone Institute.

ALI and Manufacturers Division Representatives on NCSA Board

The Agricultural Limestone Institute and the Manufacturers Division, each, are permitted, ex officio, three representatives on the NCSA Board of Directors.

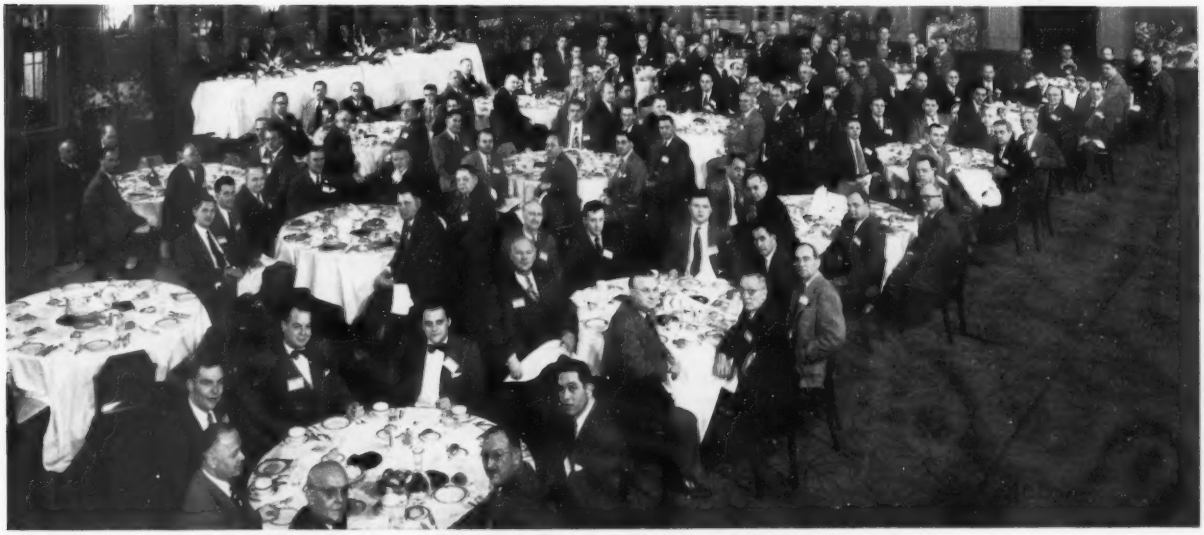
For the Manufacturers Division, the three representatives include J. Craig McLanahan, Chairman, with Cottrell Farrell and B. R. Maloney, elected at the annual meeting of the Division to serve with him.

For the Agricultural Limestone Institute, the three representatives include P. E. Heim, President, with H. A. Clark and H. C. Krause, elected at the annual meeting of the Institute to serve with him.

Manufacturers Division Re-elects J. Craig McLanahan, Chairman

Appropriately recognizing his earnestness, sincerity of purpose, and unselfish devotion of time and effort to the affairs of the Division, J. Craig McLanahan was unanimously re-elected to the Chairmanship for the ensuing year.

In addition, the following were elected as designated:



Manufacturers Division Annual Business Meeting Luncheon

Vice Chairmen

Irwin F. Deister, Deister Machine Co., Fort Wayne, Ind.
W. W. King, W. S. Tyler Co., Cleveland, Ohio
B. R. Maloney, E. I. du Pont de Nemours & Co., New York, N. Y.

Elected Directors

D. McM. Blackburn, Hendrick Manufacturing Co., Carbondale, Pa.
W. E. Collins, Jr., Atlas Powder Co., Wilmington, Del.
A. E. Conover, Hewitt-Robins, Inc., New York, N. Y.
C. R. Dodge, Northwest Engineering Co., Chicago, Ill.
L. A. Eiben, Northern Blower Co., Cleveland, Ohio
R. F. Feind, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.
E. J. Goes, Koehring Co., Milwaukee, Wis.
E. M. Heuston, Bucyrus-Erie Co., South Milwaukee, Wis.
G. C. Holton, American Cyanamid Co., New York, N. Y.
P. H. Hunter, Harnischfeger Corp., Milwaukee, Wis.
R. C. Johnson, Simplicity Engineering Co., Durand, Mich.
G. H. Keppel, C. G. Buchanan Crushing Machinery Division, Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa.
R. D. Ketner, General Electric Co., Schenectady, N. Y.
Kenneth Lindsay, Iowa Manufacturing Co., Cedar Rapids, Iowa
M. L. McCormack, Ingersoll-Rand Co., New York, N. Y.
L. C. Mosley, Marion Power Shovel Co., Marion, Ohio
R. M. Murdock, Frog, Switch & Manufacturing Co., New York, N. Y.
H. W. Newton, Barber-Greene Co., Aurora, Ill.
Milo A. Nice, Hercules Powder Co., Wilmington, Del.
F. O. Reedy, Kennedy-Van Saun Manufacturing & Engineering Corp., Danville, Pa.
L. A. Rhodes, Jeffrey Manufacturing Co., Columbus, Ohio
W. A. Rundquist, Pioneer Engineering Works, Inc., Minneapolis, Minn.
J. B. Terbell, American Manganese Steel Division, American Brake Shoe Co., New York, N. Y.
J. A. Trainor, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

Elected Representatives on NCSA Board

Cottrell Farrell, Easton Car & Construction Co., Easton, Pa.
B. R. Maloney, E. I. du Pont de Nemours & Co., New York, N. Y.

Manufacturers Division Honors Past Chairmen

A well deserved tribute was paid to past Chairmen of the Manufacturers Division on the occasion of its annual luncheon meeting held on Tuesday, February 6. As an expression of appreciation for the services each had contributed when serving as Chairman, a handsome gavel with suitably inscribed silver band was presented to each past Chairman present. All living past Chairmen had been given a special invitation to attend the Convention and were grouped together at an appropriately decorated table immediately in front of the rostrum. At the appointed time the spotlight was thrown on the table and M. B. Garber took over as master of ceremonies. This may have been a mistake, for "Mike," being the senior past Chairman, reminisced with telling effect in presenting the gavels to his fellow "Ex's." The ceremony was to have been concluded by having Secretary Boyd present Mr. Garber his gavel, but he was thrown completely off-stride when Mike, on behalf of the past Chairmen who were present, gave him a beautiful Gruen precision auto-wind wrist watch in grateful appreciation of his help in making them "Has-Beens" during his 25 years as Secretary of the Division. Secretary Boyd was so obviously surprised and pleased that it is feared he hardly did justice to the occasion in presenting Mike Garber his gavel.

Past Chairmen Manufacturers Division

Of the twelve living past Chairmen the following eight were present:

M. B. Garber—1926
Abe Goldberg—1932-3
M. S. Lambert—1937
Roy Wills—1939
J. Harper Fulkerson—1941-3
Milo A. Nice—1944-5
J. B. Terbell—1946-7
Cottrell Farrell—1948-9

A. F. King (1927), H. M. Davison (1930), C. S. Huntington (1936), and Fred Braun (1940) were unable to come, but their gavels have been sent them.

(*Continued on Page 27*)

New Board, Manufacturers Division

Hostesses for Ladies Entertainment

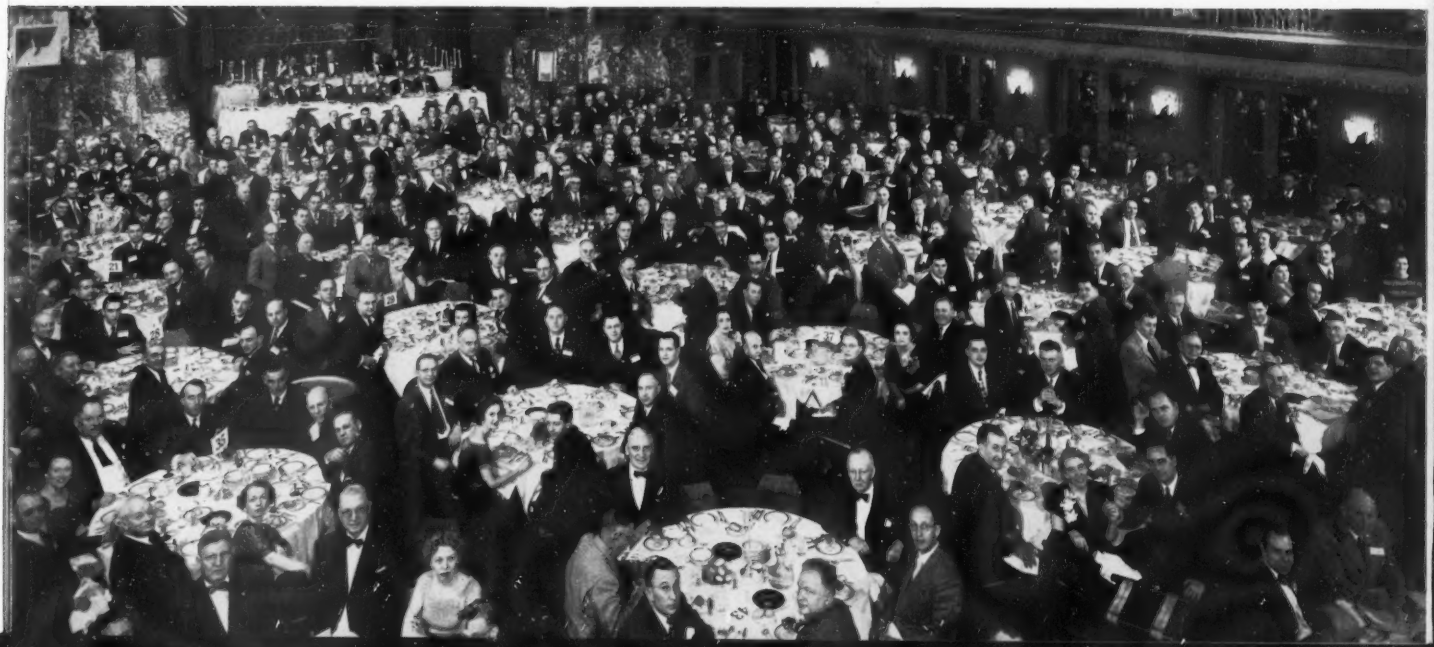
MRS. J. REID CALLANAN
South Bethlehem, N. Y.

MRS. PHILIP E. HEIM
Lowellville, Ohio

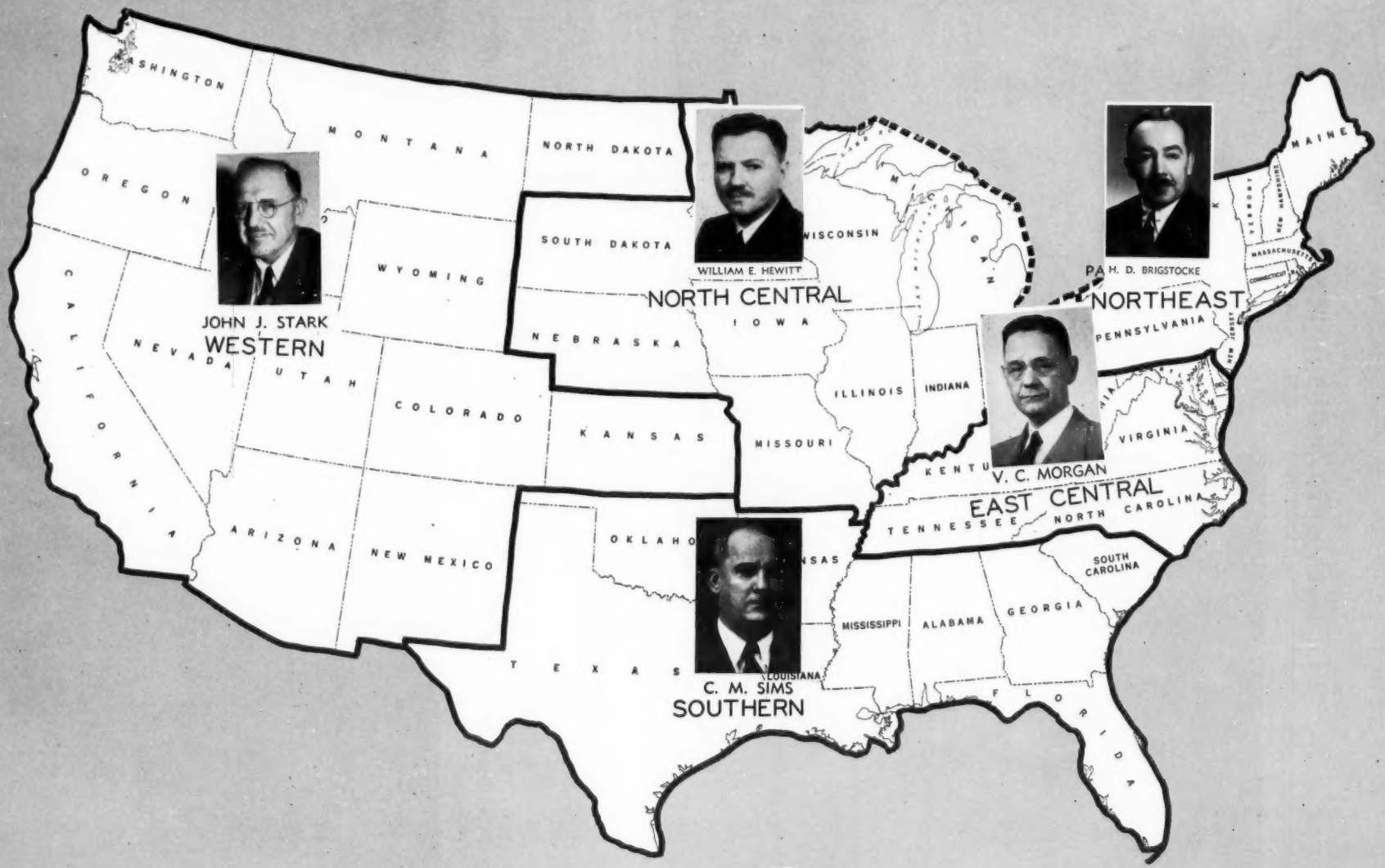
MRS. EARL P. HOLWADEL
Cincinnati, Ohio

Among Those Present at the Canasta Party for the Ladies on Tuesday Afternoon

Joint Banquet National Crushed Stone Association and Agricultural Limestone Institute Netherland Plaza, Cincinnati, Ohio, February 7, 1951



MAP SHOWING REGIONS AND REGIONAL VICE PRESIDENTS FOR 1951
AGRICULTURAL LIMESTONE INSTITUTE



Informative Talks Feature 6th ALI Convention

ALTHOUGH attendance at the 6th Annual Convention of the Agricultural Limestone Institute was somewhat hampered by bad weather and the train strike, it was the concensus of those who attended that a program standard of excellence was set which will be difficult to surpass. The speakers were most capable and informative, the business of the convention was conducted with dispatch, the entertainment was enjoyable, and the whole atmosphere of the meeting was one that reflected a serious purpose of mind intermixed with good fellowship.

First Day Shared with NCSA

Following the pattern which has operated effectively in previous years, the first general sessions were held jointly with the National Crushed Stone Association on Wednesday, February 7. The morning of that day was devoted to a panel discussion on operating problems. Four major subjects were covered, with each one being divided into two parts (for example, "Jaw vs. Gyratory Crushers in Primary Crushing") and an expert operating man assigned to each part. G. D. Lott, Jr., Vice President, Palmetto Quarries Company, Columbia, South Carolina, presided in a most capable manner, and he was well supported by the eight operating men who spoke on assigned topics and numerous producers who made contributions from the floor.

The joint luncheon at noon, with P. E. Heim presiding, was an enjoyable affair with Harold G. Hoffman, former Governor of New Jersey, as the featured speaker. At the conclusion of his address, Mr. Hoffman presented the NCSA Safety Contest awards, five of which were won by ALI members.

The afternoon session featured "Shop Talk on Employee Relationships" by Hiram S. Hall, of the Bigelow-Sanford Carpet Company of New York. Mr. Hall is a recognized authority in the field of labor-management problems and made a highly important contribution which those who attended will long remember.

As always, the joint ALI-NCSA reception and banquet was a gala affair. Especially enjoyable was the keen wit of the banquet speaker, James E. Gheen.

Greetings and Reports

President P. E. Heim opened the Thursday morning session, following a beautiful "eye-opener" movie on Hawaii, by warmly greeting all those who attended. Then came the reports of Managing Director Huschke on ALI's busy year of activities and Secretary-Treasurer Boyd on the financial condition of the organization. Mr. Boyd also spoke on governmental controls, group life insurance, and several other matters of timely interest.

The morning session ended with an address "Soils, Plants, Animals, and Men Need Lime" by Dr. Firman E. Bear, Chairman, Soils Department, Rutgers University, New Brunswick, New Jersey. Dr. Bear is an international authority on soils and soil chemistry. His address will be found on page —— of this issue of the Journal.

Conservation Wit and Conservation Procedure

W. H. Margraf, of Marble Cliff Quarries Company, Columbus, Ohio, who presided at the Thursday luncheon, introduced his personal friend, Major Norman A. Imrie, also of Columbus. Major Imrie's theme was conservation of our natural resources, which he spiced with numerous stories and sparkling wit.

Following the luncheon, Roland Crumpler, of the Washington PMA Office and well known to many agricultural limestone producers, spoke authoritatively on "Procedure for Furnishing Conservation Materials for 1951." Mr. Crumpler, who is well versed in his subject, clearly explained the procedure that should be followed and answered a number of questions from the floor.

Symposium a Big Hit

The symposium on "Transporting and Spreading Agricultural Limestone" was a very popular feature of the meeting. Six members of the industry plus an invited guest from another industry spoke briefly, concisely, and informatively on a variety of topics covering truck ownership, spreading, stockpiling, delivering, unloading frozen shipments, and the prevention of freezing. The numerous complimentary

P. E. HEIM
Carbon Limestone Co.
Lowellville, Ohio
President
Agricultural Limestone Institute

W. F. CHILDS, III
Harry T. Campbell Sons' Corp.
Towson, Md.
East Central Region

H. A. CLARK
Consumers Co.
Chicago, Ill.
North Central Region

EXECUTIVE COMMITTEE

of the

AGRICULTURAL LIMESTONE INSTITUTE

for the year 1951

A. K. HAUSMANN
Kelley Island Lime & Transport Co.
Cleveland, Ohio
North Central Region

K. K. KINSEY
Concrete Materials and Construction Co.
Cedar Rapids, Iowa
North Central Region

H. C. KRAUSE
Columbia Quarry Co.
St. Louis, Mo.
North Central Region

RUSSELL RAREY
Marble Cliff Quarries Co.
Columbus, Ohio
Representing the National Crushed Stone Association

JOHN R. RICE
Liberty Limestone Corp.
Buchanan, Va.
East Central Region

JOHN H. RIDDLE
Riddle Quarries, Inc.
Marion, Kansas
Western Region

NEWLY ELECTED TO THE ALI BOARD

R. D. DAVIS

A. W. MCTHENIA

CHARLES COBURN

W. A. CORSON

MAURICE GREENBERG

J. E. OTT

D. H. HENDERSON

remarks indicate that this kind of program is of great value to all and should be expanded in the future.

Agronomic Talks Feature Friday Session

The Friday morning session was designed to cover the three major kinds of crops, namely, field crops, vegetables, and grass. P. E. Grubb, of the DeKalb Agricultural Association, Inc., growers of hybrid seed corn, introduced and showed an excellent color movie on the growing of this important crop and the manner in which lime fits into the picture. Dr. Jackson B. Hester, of the Campbell Soup Company, told how his laboratories make thousands of elaborate soil tests each year so that farmers may grow more and better vegetable crops for the Campbell soup kitchens. R. Willis Stout, of Louisville, Kentucky, an energetic young farmer and Soil Editor of The Kentucky Farmer, gave an interesting and illustrated talk on the grassland program on his farm.

P. E. Heim Re-elected President; New Board Elected

At the Friday noon business session the Chairman of the Nominating Committee, after praising him highly for his year of service, placed the name of P. E. Heim in nomination for re-election as President of the Agricultural Limestone Institute. Mr. Heim was unanimously elected.

Five Regional Vice Presidents were nominated and unanimously elected as follows:

Northeast—H. D. Brigstocke
East Central—Verne C. Morgan
North Central—W. E. Hewitt
Southern—C. M. Sims
Western—John J. Stark

The following list, including the President, five Regional Vice Presidents, and a member of the Executive Committee of the National Crushed Stone Association, comprises the complete Board of Directors which was elected to serve until the next annual meeting:

Board of Directors

P. E. Heim, Carbon Limestone Co., Lowellville, Ohio, *Chairman*

Northeast Region

Harry E. Battin, Jr., Callanan Road Improvement Co., South Bethlehem, N. Y.
H. D. Brigstocke, Thomasville Stone & Lime Co., Thomasville, Pa.
Otho M. Graves, General Crushed Stone Co., Easton, Pa.

Meeting of Newly Elected ALI Board of Directors

East Central Region

W. F. Childs, III, Harry T. Campbell Sons' Corp., Towson, Md.
R. D. Davis, Sparta Lime Co., Sparta, Tenn.
S. B. Downing, Jr., Central Rock Co., Lexington, Ky.
A. W. McThenia, Acme Limestone Co., Fort Spring, W. Va.
Verne C. Morgan, Kentucky Stone Co., Inc., Louisville, Ky.
John R. Rice, Liberty Limestone Corp., Buchanan, Va.
F. G. White, M. J. Grove Lime Co., Stephens City, Va.

North Central Region

W. L. Bryan, Bryan Construction Co., Northfield, Minn.
H. A. Clark, Consumers Co., Chicago, Ill.
Charles Coburn, Waukesha Lime & Stone Co., Inc., Waukesha, Wis.
W. A. Corson, Inland Lime & Stone Co., Manistique, Mich.
L. R. Falk, L. R. Falk Construction Co., St. Ansgar, Iowa
J. L. Fay, Material Service Corp., La Porte, Ind.
Maurice Greenberg, Lincoln Crushed Stone Co., Joliet, Ill.
A. K. Hausmann, Kelley Island Lime & Transport Co., Cleveland, Ohio
W. E. Hewitt, East St. Louis Stone Co., East St. Louis, Ill.
K. K. Kinsey, Concrete Materials & Construction Co., Cedar Rapids, Iowa
H. C. Krause, Columbia Quarry Co., St. Louis, Mo.
W. H. Margraf, Marble Cliff Quarries Co., Columbus, Ohio
R. E. Meshberger, Meshberger Stone Co., Inc., Columbus, Ind.
Paul B. Nauman, Dubuque Stone Products Co., Dubuque, Iowa
J. E. Ott, Wallace Stone Co., Bay Port, Mich.
W. J. Stoffel, Dolese & Shepard Co., Chicago, Ill.
W. E. Stone, Piqua Stone Products Co., Piqua, Ohio

Southern Region

E. V. Scott, Southwest Stone Co., Dallas, Texas
C. M. Sims, Campbell Limestone Co., Inc., Gaffney, S. C.

Western Region

John H. Riddle, Riddle Quarries, Inc., Marion, Kans.
John J. Stark, Girard, Kans.
D. P. Thomas, Fort Scott Hydraulic Cement Co., Fort Scott, Kans.

Canada

D. H. Henderson, Canada Crushed Stone Ltd., Hamilton, Ontario, Canada

Representing the National Crushed Stone Association

Russell Rarey, Marble Cliff Quarries Co., Columbus, Ohio

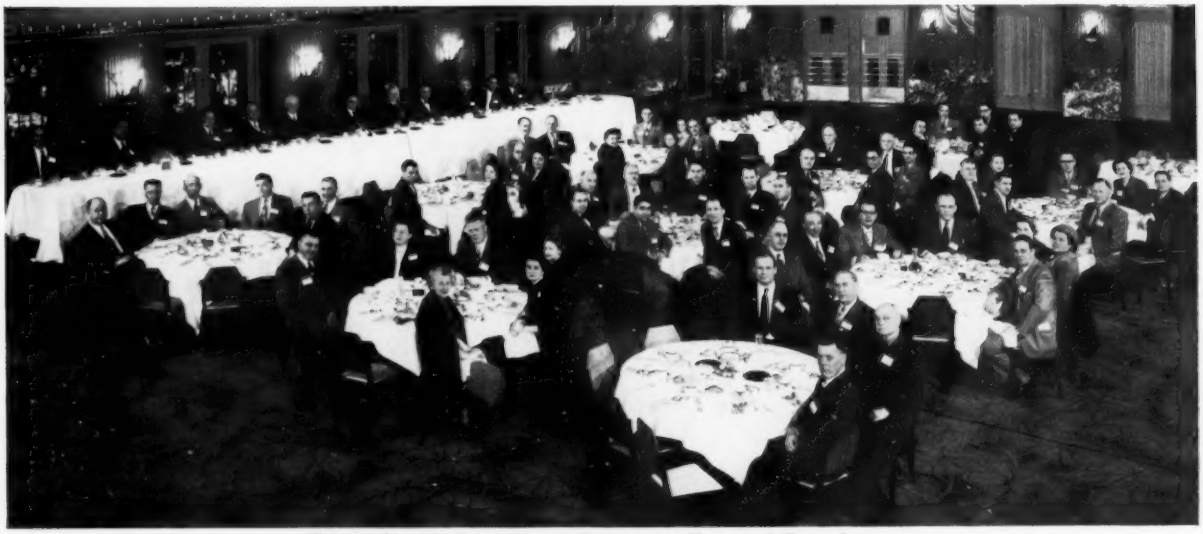
New Board Elects Executive Committee

On Friday afternoon, February 9, the newly elected Board of Directors held its first meeting. Its first order of business was to elect the following to serve as the Executive Committee for the ensuing year:

W. F. Childs, III
H. A. Clark
A. K. Hausmann
K. K. Kinsey
H. C. Krause
John R. Rice
John H. Riddle

Also included on the Executive Committee as ex officio members are P. E. Heim, President of the Institute, and Russell Rarey, who represents the National Crushed Stone Association.

The Board also elected H. A. Clark and H. C. Krause to serve with President Heim as ALI representatives on the NCSA Board of Directors. J. R. Boyd was re-elected Secretary-Treasurer.



Agricultural Limestone Institute General Luncheon
Netherland Plaza, Cincinnati, Ohio, February 8, 1951

The Practical Use of the Corps of Engineers' Tests on Bituminous Concrete*

By CHARLES R. FOSTER

Chief, Flexible Pavement Branch
Waterways Experiment Station
Corps of Engineers, U. S. Army
Vicksburg, Miss.

THE Waterways Experiment Station conducts research work on flexible pavements to develop design criteria for the Corps of Engineers. We in the Corps of Engineers feel that we have developed a procedure for designing asphalt paving mixtures and that we have criteria to determine if the mixture will satisfy the design requirements. Control procedures are available to determine within about 20 minutes after mixing whether or not the mixture is being produced as intended. It is our belief that these procedures will enable the engineer to design and produce asphalt paving mixtures with complete confidence of success.

Probably the most widely used word in asphalt paving terminology today is stability. A large amount of interest is currently centered around a stability test. Apparently paving engineers would like very much to have a stability test which would show, without question, whether the mix was satisfactory or unsatisfactory. This is certainly a desirable goal, but it has not been achieved in a completely satisfactory manner to date. The Marshall stability test used in the Corps of Engineers' procedure can be used, as brought out later, to compare one mixture against another, and it also can be used to eliminate completely unsatisfactory mixes. However, the Marshall stability test must be supplemented by other tests. The Marshall stability value is only one of five tools used in the Corps of Engineers' procedure. It is desired to emphasize that the other four tools are fully as important as the stability value.

It also is desired to point out that these procedures in their present state are applicable only to hot mixes using penetration grades of asphalt. So far, the procedures have not been developed for cold mixes and for other types of bitumens.

* Presented at the 34th Annual Convention of the National Crushed Stone Association, Netherland Plaza, Cincinnati, Ohio, February 7-9, 1951

The research work which has been conducted at the Waterways Experiment Station has shown that the most important factor in the design of an asphalt paving mixture is the asphalt content. Documentation of this is contained in a report published by the Waterways Experiment Station[1] and summarized in papers presented before the Highway Research Board.[2] These proofs are not presented here, but it is common sense that a lean mix will ravel under traffic and a mix that is too rich will rut and shove. In order to achieve maximum life, it is desirable to incorporate as much asphalt in the mix as possible without making it rich enough to rut and shove. The procedures briefly described herein determine the optimum asphalt content which is the maximum permissible value.

Laboratory Design

In comparing mixes made from different aggregates, it is necessary to make the comparisons at a comparable asphalt content. For example, it would be foolish to compare a mixture made from crushed-stone aggregate at a high asphalt content with a mixture made from an uncrushed gravel at an optimum asphalt content. The mixture with the crushed stone would rut and shove, and you would conclude that it did not have adequate stability. The mixture with uncrushed gravel would be more satisfactory than the mixture containing the crushed stone. If the comparison were made at the optimum asphalt content, the crushed-stone mix would be the better mix.

Preparation of Specimens

In the design of an asphalt paving mixture using the Corps of Engineers' procedures, the aggregates are separated into several sizes so that they can be recombined to meet a specified gradation. Each separated fraction of the aggregate and the filler is heated to temperatures between 350 and 375 F.

[1] Waterways Experiment Station Technical Memorandum 3-254, "Investigation of the Design and Control of Asphalt Paving Mixtures," in three volumes, June 1948

[2] Highway Research Board Research Report No. 7-B, "Symposium on Asphalt Paving Mixtures"

The asphalt cement also is heated, but only to a temperature of 250 to 280 F. Fig. 1 shows the aggregate-heating facilities at the Waterways Experiment Station. After all materials have reached the desired temperature, the bowl in which the mixture is to be prepared is placed on a balance and tared. The aggregate and filler are then

FIGURE 1
Aggregate-Heating Facilities

scooped from the heating pans, weighed in proportions calculated to give approximately 3000 grams of the desired blend, and then thoroughly mixed by a trowel or large spatula. The bowl and aggregates are rebalanced on the solution balance and the hot asphalt cement is introduced in the required amount.

Specimens must be prepared at a range of asphalt contents since the primary objective of the test method is to determine the optimum asphalt content. An estimate of the optimum asphalt content is based on judgment and past experience with similar mixtures. Specimens are prepared at the estimated optimum asphalt content and generally at asphalt contents 1 and 2 per cent above and below the estimated optimum asphalt content. Experience has indicated that at least four test specimens are required at each asphalt content to assure consistent test data.

Mixing is accomplished immediately after the introduction of the asphalt cement and should be completed as rapidly as possible. Mixing may be done either by hand or in a mechanical mixer. A 10- to 14-quart bread-dough mixer is recommended. Fig. 2 shows the mixing. Thorough mixing should be accomplished within two minutes, and the temperature of the mixture should not be below 225 F. upon completion of mixing.

Immediately after mixing is completed, the mixture is transferred from the mixing bowl to a large pan, divided equally, and each half placed in a compaction mold. After the mixture has been placed in the mold, the mold assembly is placed on a heavy substantial compaction base, a heated compaction hammer is placed on the specimen, and 50 blows of the hammer are applied. After this the base plate and collar are removed and the mold reversed and reassembled so that the base plate is adjacent to the original top of the specimen (Fig. 3). Fifty blows of the compaction hammer are then applied to this face of the specimen. This compactive effort will produce specimens which will have densities comparable to pavements subjected to traffic of airplane tires inflated to 100 psi. For tires inflated to higher

FIGURE 2
Mixing Asphalt Paving Mixture

pressures, it is necessary to use more blows as the higher tire pressures will produce higher densities in the pavement. After compaction is completed the base plate and collar are removed and the mold with the specimen inside is immersed in cool water for approximately two minutes, after which the sample is removed from the mold.

Density Measurements

Specimens may be tested at any time after preparation. Weights are determined for each specimen by weighing in air and in water (to obtain the volume) (Fig. 4). The water should not contain an excess of suspended or dissolved materials and its temperature should be approximately 77 F. The volume of specimens having an open texture is determined by measuring their height and diameter as accurately as possible or by coating with paraffin.

Stability and Flow Tests

Prior to stability and flow tests, the specimens are immersed in a water bath at 140 F. Where the samples are cold, they should remain in the bath for 20 minutes, but where they are warm, as they

FIGURE 3
Compaction of Specimen

will be immediately after compaction, a 10-minute period is sufficient. To conduct the stability and flow test, the specimen is removed from the hot water bath and placed on its side in the lower part of the breaking head; the complete assembly is then placed in the compression machine (Fig. 5). The flow meter is placed on one of the guide rods and pressed down against the upper test head, and the initial reading of the flow meter is made and recorded. Load is then applied to the specimen to produce deformation at a rate of 2 inches per minute. Failure of the specimen is recorded when the load-measuring dial reaches its maximum reading and begins to return toward zero. The total pounds required to produce failure of the specimen are recorded as its stability value.

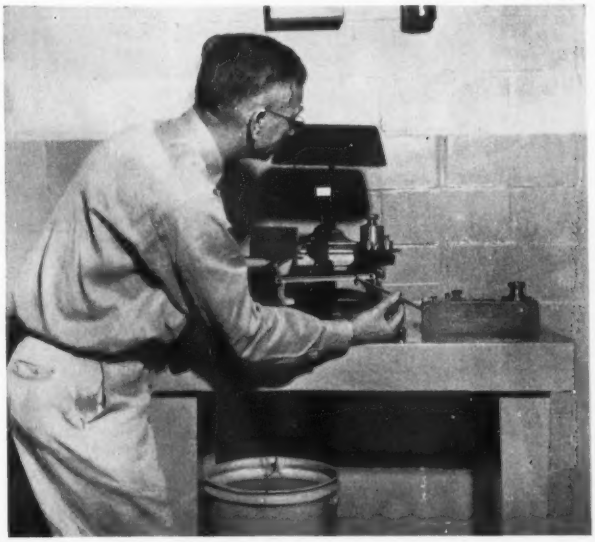


FIGURE 4
Weighing Specimen

The flow value is obtained during the test for stability. When the load is being applied to the specimen, the flow meter is held firmly against the top of the upper test head so that the guide rod pushes the flow meter gage upwards as the sample deforms. When the maximum stability reading is obtained on the load-measuring dial, the flow meter is removed from its position on the guide rod. The difference between the initial and final readings expressed in hundredths of an inch is recorded as the flow value.

Fig. 6 is a view af the laboratory at the Waterways Experiment Station showing the aggregate-heating facilities (near windows), weighing operations (right center), mixing (left center), compaction (left), and stability test (right).

Presentation of Data from Tests

Data obtained as outlined above furnished the basis for determining, either directly or by compu-

tation, the following properties of each test specimen:

a. Flow
b. Stability
c. Unit weight, total mix
d. Per cent voids, total mix
e. Per cent voids filled with asphalt cement

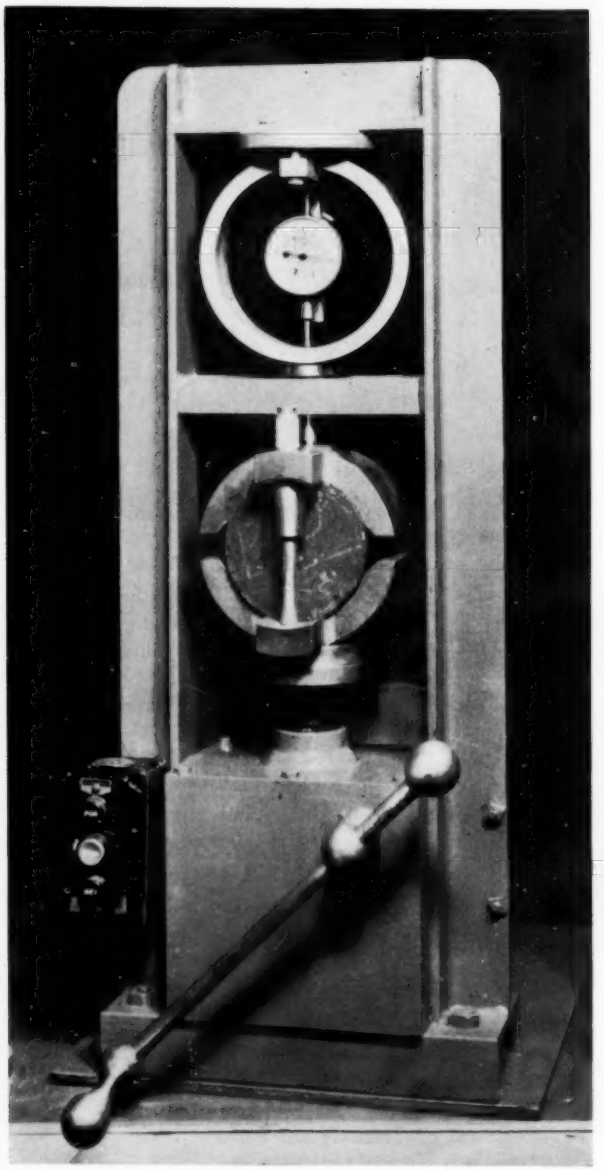


FIGURE 5
Specimen in Stability Testing Machine

Average values at each asphalt content are then determined for each of the above test properties. Individual test values which are at considerable variance with the average may be discarded. The average test properties outlined above are then plotted versus asphalt content on separate diagrams and smooth curves are drawn through the plotted points (Fig. 7).

Selection of Optimum Asphalt Content

An example of the selection of optimum asphalt content is shown for the test results plotted on Fig. 7. Using the criteria for asphaltic concrete, the following asphalt contents have been selected for the various test properties:

Test Property	Selected Asphalt Content, per cent
Stability	5.3
Unit weight, total mix	5.5
Voids, total mix	5.8
Voids filled with asphalt	6.3
Average	5.7

The individual test properties at the average asphalt content of 5.7 per cent are then reexamined to determine how closely they agree with the criteria.

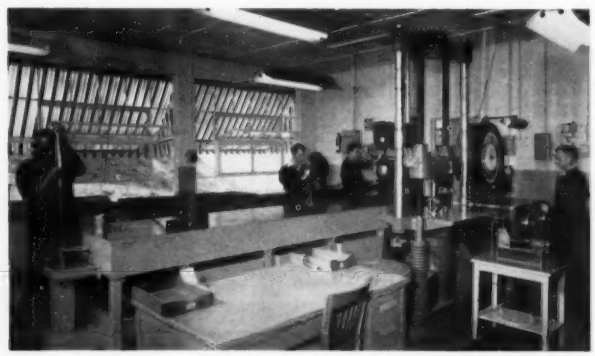


FIGURE 6
View of Bituminous Laboratory at Waterways Experiment Station

At this asphalt content the flow value is 14, stability is 700 lb., voids total mix is 4.1 per cent, and voids filled with asphalt is 76 per cent. All values are in reasonable agreement with the criteria. The variables that are present during construction are recognized. The value of 5.7 per cent does not imply

absolute accuracy but may vary within a range of values for the criteria. For example, inspection of the test properties curves on Fig. 7 shows that at asphalt contents between 5.5 and 6.0 per cent the individual values are in substantial agreement with the criteria, and any value between these limits may be acceptable for construction.

Comparison of Different Blends

The above procedures demonstrate the selection of the optimum asphalt content for a given blend.

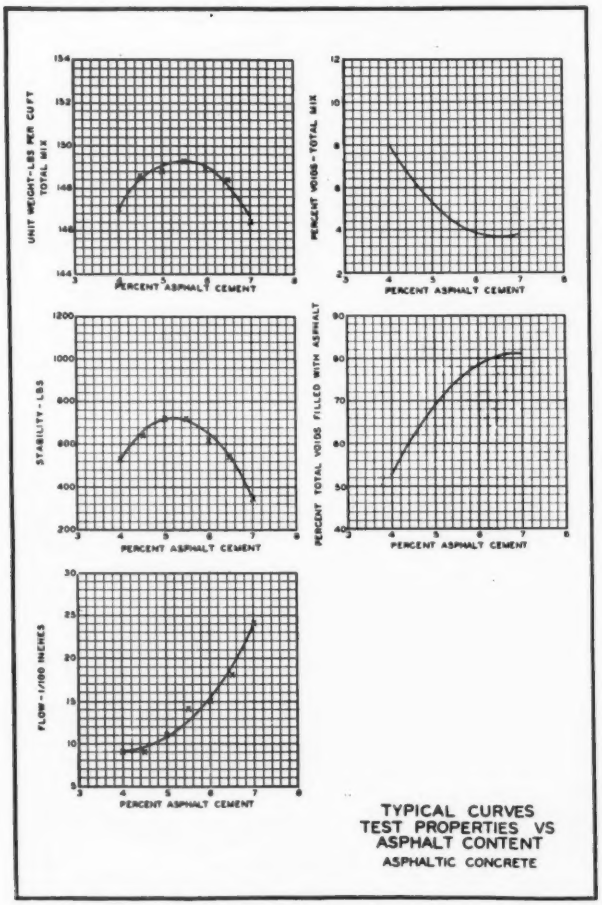


FIGURE 7

Where the designer has the choice of several blends, these procedures would be followed for each blend and the test properties of the blends compared at optimum asphalt contents. The choice of the blend to be used in the pavement would be based on economics and a consideration of the requirements in the specific case. For example, if the paving mixture is to be used for secondary roads and a mix made of local pit-run aggregate would be cheaper, the mix would be used if the test properties were within the established criteria. However, if the pavement were to be used for heavily trafficked highways, it no doubt would be desirable to forego economics to some extent and select the blend with the higher stability which would be that containing crushed-stone aggregate. It is desired to emphasize that these procedures permit the design engineer to compare blends on a reasonable basis and to select the mixtures which meet his needs in the most economical manner.

Plant Check

Once a blend is selected, it is not sufficient to assume that the pavement will be constructed as intended. Mix designs based on laboratory samples are not adequate because the plant-produced materials seldom, if ever, equal the laboratory samples. In plant operations, aggregates are combined and this combination is seldom accurately controlled. Also, fine material is lost as it goes through the drier. It is necessary, therefore, to check the mix design as soon as the plant is in operation.

It is recommended that as soon as the plant is placed in operation dry batches be taken from each of the bins and the procedures described above be repeated. On the basis of these tests the actual job-mix asphalt content should be established.

Control Procedures

It is further recommended that definite control procedures be set up at the plant to insure that the mix is produced in accordance with the intended desires. A sample of paving mix adequate for the preparation of four test specimens should be obtained from each of the first four truck loads of paving mix upon initiation of plant production. Four specimens should be compacted from each of these samples and tested in accordance with standard procedures previously cited. The tests should be conducted as rapidly as possible, and plant production should be delayed until the test properties of these compacted specimens are available. The test properties should be compared with those for the final mix design. If necessary, proper adjustments should be made to secure a conformable mix.

Generally, the flow value is a satisfactory criterion of the mixture and resumption of plant pro-

(*Continued on Page 21*)

NCSA Holds Fourth Short Course For Crushed Stone Salesmen

By A. T. GOLDBECK

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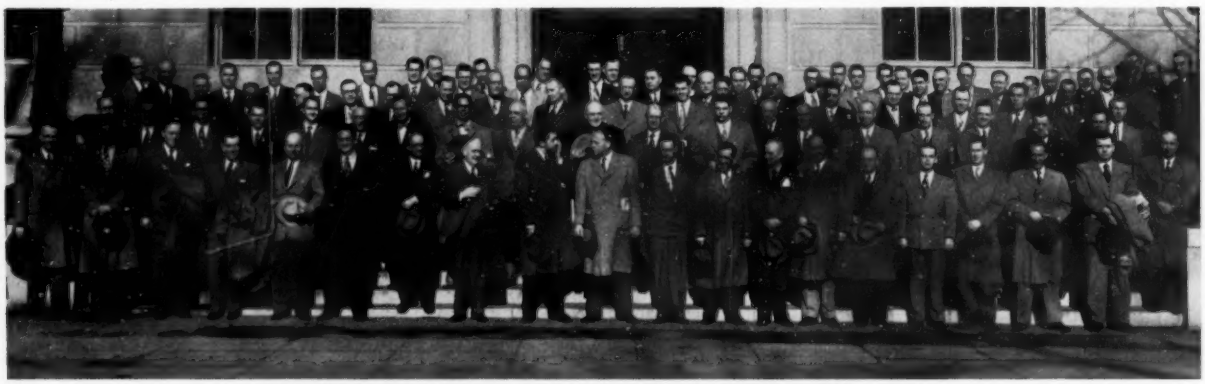
THE short courses for salesmen which have been given by the National Crushed Stone Association during past years have evidently been of value to those attending. Each successive course has had a larger attendance than that preceding and the programs have been increasing in diversity and interest.

On January 3, 4, and 5, 1951, the fourth short course was given in one of the assembly rooms of the U. S. Chamber of Commerce. The accommodations provided were eminently suitable for our purpose and the impression of luxurious comfort did much to help sustain the interest of the audience throughout the entire three days of lectures. On the fourth day, laboratory demonstrations were conducted in the National Crushed Stone Association Laboratory.

The philosophy of the short course may be summed up in the thought that a salesman should be particularly well informed on the product he is selling. As applied to crushed stone salesmen, it is our belief that he should have some knowledge of the various kinds of rocks and how they were formed; something of their physical characteristics and, in a general way, how these characteristics are determined. He should be familiar with the accepted best construction practices for the various types of construction and why certain practices lead to good or poor results. The combination of stone with other materials to prepare concrete or bituminous concrete should be understood, perhaps not with the exactness and detailed knowledge expected of the engineer specialist, but at least in enough detail to permit him to intelligently consider these materials and their uses.

We were fortunate in being able to secure some of the foremost engineering experts in the United States to talk on their particular subjects. This was made possible by holding our course during the week just prior to the annual meeting of the Highway Research Board, and so we were able to obtain the services of many of our speakers from these highway experts.

The subjects covered included a discussion of some of the fundamentals concerning crushed stone, such as mechanical analysis and the plotting of sieve tests, specific gravity and its application to calculations for density and voids, the proportioning of concrete, the control of ready mixed concrete, stone sand, fire resistance as affected by aggregates, identification of rocks and the effect of deleterious materials, stone for rip rap, the effects of flat and elongated pieces, subgrade soils, gradation of stone for sub-bases and insulating courses, the estimation of quantities, the



NCSA Fourth Short Course for Crushed Stone Salesmen
Held in Washington, D. C., on January 3-5, 1951

latest developments in macadam road machinery, bituminous surface treatments, dusty stone, the proportioning of bituminous concrete, design of the flexible pavement, some concrete pavement details necessary for their success, and the effect of aggregates on concrete pavement durability. The widening and resurfacing of old pavements was presented by a panel of experts.

In the laboratory, a concrete mix was designed on the spot, the mix made up and all of the needed calculations shown. Likewise, bituminous concrete specimens were formed and the necessary calculations to determine whether the mix would shove or be non-durable were made and explained.

It was very important to have the talks clearly presented and all of the equipment needed to accomplish this purpose was provided, including projection apparatus, a lapel microphone, and a specially constructed, well lighted blackboard. All talks were run off on a time schedule and the program was not allowed to drag. Thus, the interest of the audience was sustained throughout the entire program.

A very enjoyable and valuable part of the program was a "Get-Together Party" for everyone attending, given at the Mayflower Hotel. Here acquaintances and friendships were made and a lot of experiences and information was exchanged.

It may be interesting to know that there was a total registration of 144, including 92 representatives of member companies with representation also from state highway departments and governmental departments.

Tests on Bituminous Concrete

(*Continued from Page 19*)

duction may be expedited by comparing only the values of flow with corresponding data from the final design. The average flow values obtained from truck samples should be in substantial agreement with flow values from the final design. Variations of not more than two points in flow are allowable. In no case, however, should the plant-produced mix be considered acceptable if the flow exceeds 20. Also, the mixture should not be accepted if the stability is less than 500 lb. Plant production should be delayed, if test property variations exceed those noted above, until the cause of these variations is determined. Computations for scale weights should be checked first. If no error is found in these computations, the plant scales should be recalibrated. Variations of only a few tenths of one per cent of asphalt content may cause variations of two or three points in the flow value. If the variations are caused by changes in the gradation of the aggregate, it may be necessary to readjust the job mix or to change the asphalt content slightly.

After all adjustments are made and the plant has been placed in continuous operation, test specimens should be prepared from only about every tenth truck load. In addition to stability and flow, the unit weight, the voids in the total mix and per cent voids filled with asphalt should be computed and compared with the final design values.

Summation

In summation, it is desired to review the three steps in the Corps of Engineers' design and control procedures for asphalt paving mixtures. These are: (a) the initial design in the laboratory, (b) the final design using plant-produced samples, and (c) the control tests made during construction. In the initial design, the aggregates available for use in the proposed pavement are compared at optimum asphalt content and the selection of the aggregate to be used is made on the basis of economics and the design requirements. Since the aggregate produced at the plant usually varies from that obtained for laboratory samples, it is necessary to check the design just prior to the state of production and make such adjustments in the mixture as are necessary to produce a mix at optimum asphalt content having the desired test properties. It also is necessary to make spot check tests at intervals to assure that the mix is being produced as designed, since the aggregate grading will vary during the course of production. It is believed that, with these procedures, the pavement engineer can construct an asphalt pavement with full confidence that he has made a satisfactory selection of materials and designed a mix which will fulfill its intended use, and, further, that he has constructed a pavement which conforms to his design standards.

Soil, Plants, Animals, and Men Need Lime[1]

By DR. FIRMAN E. BEAR

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ON Tuesday, August 16, 1949, *The New York Times* published an item about Edmund Sumter Ruffin, oldest member of the Norfolk bar, who had died at the age of 88. One of the important facts about this man, which *The Times* saw fit to record, was that he was the grandson of Edmund Ruffin, a "pioneer agronomist" of Virginia. This Edmund Ruffin, the grandfather, was the author of a very famous book entitled "An Essay on Calcareous Manures," the first edition of which appeared in 1832. That was 119 years ago.

This book is remarkable in that its author presented an astonishingly clear picture of the need for lime in restoring the productivity of the exhausted soils of Virginia. He had surveyed the English and French literature on the subject. He had carried on elaborate experiments of his own, and had reported on them. To him, more than to any other man in this country, may be given the credit for first setting down the fundamental principles involved in liming lands and in arousing early and widespread interest in the practice.

The names of four other soil scientists, all of whom were prominent members of state agricultural experiment station staffs, merit special mention in this connection. These were Homer J. Wheeler of Rhode Island, William Frear of Pennsylvania, Charles E. Thorne of Ohio, and Cyril G. Hopkins of Illinois. To these men, all of us owe a great debt of gratitude for having carried out the careful field studies on which our present liming practices are so largely based. These men stimulated thought and action toward getting lime applied to the land, as the first step in maintaining it at a high level of productivity for the kinds of crops we need more of for animal and human consumption.

Practice of Liming Firmly Established

Liming the land is now a firmly established practice in all the progressive countries of the earth. In 1949, 26 million tons of liming materials were applied to the farmed lands of the United States. Of that quantity, 25 million tons were limestone. These figures show that a great many farmers in this country believe in the use of lime and that more than 95 per cent of these men prefer to use limestone.

The agricultural limestone industry is mostly confined to that part of the United States where the annual rainfall is in excess of 30 inches. This includes virtually all of the land east of the 100th Meridian and the high-rainfall area along the Pacific Coast, including northern California, Oregon, and Washington.

In this eastern half of the United States, rainfall increases from west to east and from north to south. In proportion as more rain falls, larger amounts of the soil's natural supply of lime are dissolved, carried down the rivers, and dumped into the sea. This leaching process has been going on for many millions of years with the result that large areas of land have lost virtually all their carbonate of lime and have become strongly acid.

Tremendous tonnages of rock, and soil-derived lime have been laid down on the ocean floor. Fortunately many ancient seas are now dry land and many such lime deposits, which have been consolidated into rock, are now available for use. Once the overburden has been removed, deep beds of limestone, which vary from almost pure calcium carbonate, or calcite, to equimolecular quantities of calcium and magnesium carbonates, or dolomite, are exposed to view.

Soil Test Discloses Lime Need

Fifty years ago, there was no very dependable method for determining when lime was needed and how much should be applied. Now we know that two factors are involved, one of which is an "intensity factor" and the other a "capacity factor". The first is measured by a pH meter and the second by a method that takes into consideration the clay and organic-matter content of the soil. When both these measurements have been made, we are in a position to make dependable recommendations about liming the land. Five hundred pounds of limestone may be enough to raise the pH value of the plow depth of a sandy soil from 5 to 6. For a loam, 2 or 3

[1] Presented at the 6th Annual Convention of the Agricultural Limestone Institute, Netherland Plaza, Cincinnati, Ohio, February 7-9, 1951

tons may be required. For a peat or muck soil, 10 tons may be needed.

Fifty years ago, much of the limestone used on the farm was prepared for use by burning in home-made kilns or by crushing in portable mills. Now the job has been taken over by large limestone producers who prepare the material in accordance with definite specifications as to purity and fineness. Much of the agricultural limestone is now a first-class product. To the west, the tendency is to favor the coarser grades of limestone, whereas the finely pulverized products are favored in the east. The important point for the farmer to realize is that if he wants quick results the limestone must expose a lot of surface to the solvent action of the soil. That requires fine pulverization. This is especially important for the dolomitic types of limestone.

Fifty years ago, farmers hauled their liming material home from the nearest available source of supply, transferred it by hand to a spreader, and distributed it by horse power over their fields. It took a lot of time and a lot of hard work to get the job done. Today many farmers merely reach for the telephone, call their limestone producer, and soon thereafter the limestone is being spread over their fields by truck without any physical effort on their part. In proportion as this type of service has been made available to farmers, larger tonnages of liming materials have been applied to the land in this country.

Liming the land has been reduced to a fairly exact science. The soil on many farms is being tested from time to time and limestone is being applied in accordance with the results of these tests, taking into consideration the needs of the crops that are to be grown. So many soil tests are now being made yearly that state and private testing laboratories are finding it difficult to meet the demand for such service. Limestone, fertilizer, and canning companies test soils. So also do some farmer cooperatives. Many of the larger farmers have individual test kits. Some of them have their own soil-testing laboratories.

There are many differences of opinion among those who have to do with recommendations as to what constitutes good liming practice. Soil scientists from Ohio, New York, Pennsylvania, New Jersey, and Maryland have just completed the material for a joint bulletin entitled "One Hundred Questions and Answers on Liming the Soil." It took 4 years for these men to reach an accord on the answers to these questions, and much compromising had to be done.

Minor Elements Affected

There are still a lot of things we don't know about liming the land. Among the many points at issue in the five-state discussions was that of the pH value at which it is desirable to maintain the soil in humid regions for best results with most crops. It was finally agreed that, except for such acid-soil crops as potatoes and blueberries, the aim should generally be to maintain the pH value of the plow depth of soil between 6.0 and 6.5. This decision is based on the knowledge that if the pH values are pushed above 6.5 the solubilities of some of the essential minor elements, notably manganese, zinc, cobalt, and copper, may be so reduced that a lack of one or more of them may become a limiting factor in crop or livestock production. This is especially true with the sandier types of soil, such as are found on the coastal plains along the Atlantic Ocean and the Gulf of Mexico. But such minor-element deficiencies are not confined to sandy soils.

The availability of some nutrient elements, including one of the minor-element group, increases with rise in pH values. The minor element referred to is molybdenum. This element is known to be essential for nitrogen fixation by the nodule bacteria of legumes and for reduction of nitrates in protein production in non-legumes. There is considerable evidence that a very important reason for liming the soil is to increase the availability of the molybdenum in it. In some cases, it is conceivable that as little as 1 pound sodium molybdate could take the place of 1 of the 2 tons of limestone that are often applied to each acre in the liming program.

Liming Replaces Acid Hydrogen With Ca and Mg

The primary purpose of liming acid soils is to replace the acid hydrogen with alkaline calcium and magnesium. But the soil's exchange complex must also contain potassium. There are very good reasons for maintaining these four elements in fairly definite ratios in the exchange complex. In New Jersey, we have come to the conclusion that the hydrogen, calcium, magnesium, and potassium should be kept as nearly as feasible at ratios of 20, 65, 10, and 5, respectively. This is in terms of equivalents, rather than as percentages of the elements. On an equivalent basis, 1 part H will replace 20 parts Ca, 12 parts Mg, or 39 parts K.

Three important points are involved in suggesting that these four elements be maintained in about these ratios in the soils of humid regions. Any very marked departure from them may lead to a deficiency of some needed element in the plant. It may result in nutritional disturbances to the consumer of the plant, whether animal or man. It may increase the cost of growing the crop.

The hydrogen values of soils are important in relation to the availability of most of the minor elements. The potassium values determine, to a very large degree, how much calcium and magnesium the crop will be able to obtain from the soil. Given the opportunity, the plant will take up three or four times as much potassium as it requires for optimum growth, at the expense of its calcium and magnesium. The equivalent sum of calcium, magnesium, and potassium in a given species of plant, under uniform environmental conditions, tends to be a constant. But the amount of any one of these elements may vary within very wide limits without affecting yield. An abnormally high content of potassium is objectionable not only from the point of view of the consumer, but it makes crop production unduly expensive.

Potassium Supply Can Be Excessive

Potassium has value to animals and man, but an excess should be avoided. One of the serious diseases of cattle in the regions where winter wheat is pastured is grass tetany. The potassium content of this pastured wheat has been known to be as high as 5 per cent of its dry weight. As a result, the amount of calcium and magnesium in the crop is greatly reduced. The imbalance between potassium and calcium interferes with the normal rhythm of the heart. Grass tetany is relieved by an injection of calcium gluconate. The same remedy is applied to overcome milk fever in cows, and probably for the same reason. In some cases, excessive soil potassium causes the magnesium content of the feed to be too low. This affects muscular activity and calls for the supplemental use of magnesium either by way of the feed or by injection into the bloodstream.

In proportion as more potassium is taken up by plant roots than the plant requires for optimum yields, the cost of production of the crop is greatly increased. Let us assume that limestone costs $6 a ton applied to the land and that the 60-per cent grade of muriate of potash sells at $60 a ton. On this basis it costs nearly 16 times as much to supply an equivalent of potassium as it does one of calcium. This means that, for greatest economy in production, the soil and plant should be fed as much calcium as possible, up to the point where yields begin to fall off because of deficiency of some other element.

Even though the equivalent ratio of calcium to potassium in the exchange complex of the "ideal soil" is set at 13:1, a corn plant growing on that soil will contain only 1/3 to 1/2 as many equivalents of calcium as of potassium. In other words, plants have such a marked capacity to extract potassium from the soil's exchange complex that it is difficult to prevent waste of this element. The answer to this problem lies not only in keeping the soil well limed but in applying potassium in relatively small annual doses rather than in large infrequent doses.

Humans and Animals Need More Calcium

Within limits, the absorption of unneeded potassium does not harm the plant. But the value of the plant for animal or human consumption is impaired. The amount of calcium in the human body is about 3.75 per cent of the dry weight. This is nearly 20 times the percentage of this element in the dry matter of the corn plant. In contrast, the potassium percentages of the corn plant and of man, on the dry-weight basis, tend to be almost identical. From this it is apparent that whereas potassium tends to concentrate in plants, animals have greater need for calcium. From 5 to 10 pounds of ground limestone is being added to every ton of open-formula dairy-cow feed produced by the G. L. F. farmers cooperative, and from 20 to 40 pounds to every ton of poultry feed.

It is highly important that the calcium needs of animals and man be met. The most effective means of meeting them is by applying lime to the soil. This permits of much of it being used twice, first by the plant and then by the animal. Lime should be applied liberally and regularly. If the crops we are growing permit of it, we should not only maintain the plow depth of soil at a pH value between 6.0 and 6.5 but a considerable depth of subsoil as well. This latter is best accomplished by plowing lime under.

The starting point in correcting the acidity of a strongly acid soil is to apply the lime to the plowed soil and work it in thoroughly. Once the acid conditions in the plow depth of soil have been corrected, then it becomes logical to apply lime for maintenance purposes to the sod crop in the rotation and

plow it under. By this procedure we finally arrive at a deep, well-limed soil capable of producing high acre yields of the most important grain, grass, legume, and vegetable crops.

Soil Properties Improved

Lime often effects marked improvement in the physical properties of soils in humid regions. This is largely an indirect effect in that it is a result of the larger and more extended root systems of the crops that grow on well-limed soils. Greater amounts of the above-ground parts of plants are also available for incorporation into the soil. One result of these increases in quantity and depth of organic matter is a much improved granulation of the soil. Another is an increase in the number and activity of earthworms. Organic matter serves as food for earthworms. They eat their way through the soil, leaving air and drainage channels behind. Thus the soil's capacity for water intake is increased, as is the rate at which any excess will move downward to ground-water levels instead of running off the land.

It is a well-known fact that soils of limestone origin are naturally highly productive. The soil itself may contain no limestone, being made up merely of the impurities that the limestone contained. But there is always some free lime in their subsoils, and they are often underlain by thick deposits of limestone. They are usually very well-drained. This permits of deep rooting, as a result of which the roots are able to reach this limestone and to be benefited by it.

Considering the fundamentally important benefits to be derived from liming the soil, both in terms of crop improvement and of extra values to animals and man, one is impressed with the fact that the rate of increase in consumption of liming materials is not as rapid as that of fertilizer. We are now using about 18 million tons of fertilizer, which is nearly 70 per cent of the tonnage of liming materials. It appears probable that fertilizer tonnages will surpass those of liming materials in the relatively near future.

Vigorous Sales Campaign Suggested

Fertilizer is being aggressively sold, whereas producers of liming materials tend more to be satisfied with whatever orders may come their way. This means that a great many farmers who should be buying lime are buying extra fertilizer instead. There is reason to believe that if an extra 25 cents were added to the present selling price of every ton of liming material and the 6.5 million dollars thus made available were used in sales promotion for lime, this would result in great advantage to the producer of liming materials, the farmer who uses them, and the man who consumes the products of the soil.

Everybody agrees that acid soils should be limed. There is general acceptance of the principle that liming is essential for high levels of productivity of most crops. It is my opinion that the industry would be well advised to carry on continuously a well-documented advertising program that is designed to educate the public to a realization that the liming of acid soil is essential not only for the benefit of the soil, the crops that grow on it, and the livestock to which the crops are fed, but for the sake of the people who consume the products of the farm as well. The primary aim of man is to improve conditions for man himself. The starting point is the soil. And lime is the first requisite of a productive soil.

Announcing . . .

- 35th Annual Convention of NCSA
- 7th Annual Convention of ALI
- Manufacturers Division Exposition

★

WEEK OF FEBRUARY 17, 1952

THE STEVENS

CHICAGO, ILL.

A. T. GOLDBECK RECEIVES DISTINGUISHED AWARD

THE Highway Research Board of the National Research Council paid signal honor to A. T. Goldbeck, Engineering Director of the National Crushed Stone Association, when at its annual meeting in Washington, D. C. on January 10, 1951, he was presented with the organization's Distinguished Service Award.

Mr. Goldbeck's many friends throughout the crushed stone industry are justifiably proud of this fine tribute to his outstanding accomplishments in the field of highway research. There is shown below the certificate of award and the citation which accompanied it.

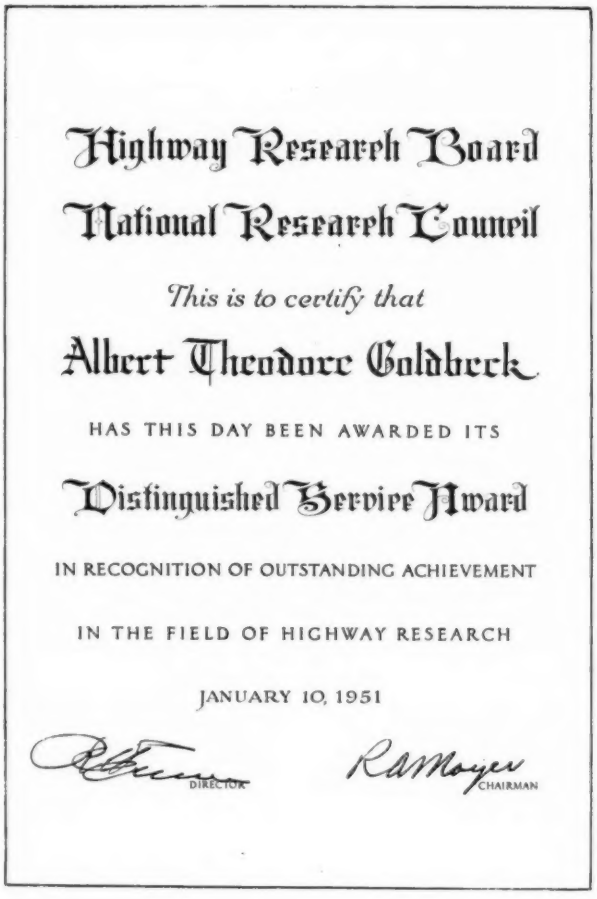
ALBERT THEODORE GOLDBECK was present when the Highway Research Board was organized and he attended the first annual meeting. At that early time he was already distinguished as a leader in engineering research and became the first chairman of one of the first committees of the Board. His career from that time to this has been studded with important contributions to engineering and scientific knowledge.

A native of Philadelphia, Mr. Goldbeck was graduated from the University of Pennsylvania with a degree of Bachelor of Science in Civil Engineering in 1906, and received the degree of Civil Engineer in 1923. Following graduation he served as instructor at his alma mater for two years and at Lafayette College for two years before entering upon his lifetime research career.

Mr. Goldbeck joined the staff of the Office of Public Roads in 1910, became Assistant Engineer in Charge of the Philadelphia Municipal Laboratory in 1913, rejoined the reorganized laboratory of the Bureau of Public Roads and Rural Engineering in 1915, and served the Bureau successively as Engineer of Tests and Chief of the Division of Tests. In these capacities he conducted and directed researches in concrete pavement design which included studies of stress distribution under static and moving loads, subgrade pressure measurements, studies of subgrade friction, impact studies, the flow of concrete, measurements of expansion and contraction, and other studies pertaining to pavement design. The Goldbeck soil pressure cell is a well known instrument developed in this period.

Since 1925 Mr. Goldbeck has been connected with the crushed stone industry in the capacity of Engineering Director of the National Crushed Stone Association. During the past forty years, he has been active and prominent in a number of technical organizations including the American Society for Testing Materials, American Concrete Institute, American Institute of Mining and Metallurgical Engineers, The Association of Asphalt Paving Technologists, American Road Builders' Association, American Association of State Highway Officials, American Railway Engineering Association, The Highway Research Board, and others. He was the first chairman of the Board's Committee on Sructural Design of Highways, and served in that capacity some fourteen years. He was a member of the Executive Committee from 1931 to 1939 and Chairman of the Highway Research Board during 1934 and 1935. He continues to be active in the Highway Research Board and other organizations and is now Vice President of the American Concrete Institute. He has been honored by election to the Society of Sigma Xi.

The record of Albert Theodore Goldbeck is one of distinguished public service in the search for scientific knowledge.



Highway Research Board

National Research Council

This is to certify that

Albert Theodore Goldbeck

HAS THIS DAY BEEN AWARDED ITS

Distinguished Service Award

IN RECOGNITION OF OUTSTANDING ACHIEVEMENT

IN THE FIELD OF HIGHWAY RESEARCH

JANUARY 10, 1951

DIRECTOR

CHAIRMAN

34th Annual Convention

(*Continued from Page 8*)

Safety Awards Presented at Wednesday Luncheon

Featuring the program at the Joint Luncheon of NCSA and ALI, on Wednesday, February 7, was the presentation of safety awards to winners in the NCSA Safety Contest. The names of the winners and the man primarily responsible for each plant's record were prominently displayed (photograph at right) throughout the Convention period. Harold G. Hoffman, former Governor of New Jersey, honored us by presenting the awards to representatives of the winning plants, following his highly entertaining talk entitled "Gripes and Grins."

Detailed information concerning the results of the contest were fully reported in the September 1950 issue of the Crushed Stone Journal. Representatives of winning plants who were present to receive their awards are shown in the picture below.

Governor Hoffman Congratulates 1949 Contest Winners

Top row left to right:

J. T. JONES, Superintendent, N. R. Garrett City Road and Agricultural Stone Quarry, N. R. Garrett City Quarry Co., Columbia, Boone County, Mo.

T. W. JONES, Engineer, Middlefield No. 1 Trap Rock Quarry, New Haven Trap Rock Co., Middlefield, New Haven County, Conn.

W. F. WISE, President, Plant No. 4 Trap Rock Quarry, Southwest Stone Co., Knippa, Uvalde County, Texas

Middle row left to right:

EDGAR Z. COLE, Plant Superintendent, Rock Hill Trap Rock Quarry, General Crushed Stone Co., Quakertown, Bucks County, Pa.

RAY COOK, Owner, Ames Ag Lime & Road Stone Quarry, Ray Cook Construction Co., Ames, Story County, Iowa

BURR SHAVER, Plant Supt., White Haven Sandstone Quarry, General Crushed Stone Co., White Haven, Luzerne County, Pa.

MERLE PRICE, Plant Superintendent, LeRoy Limestone Quarry, General Crushed Stone Co., LeRoy, Genesee County, New York

Front row left to right:

J. GILMORE WILSON, General Superintendent, Cedar Hollow Lime Quarry, Warner Co., Devault, Chester County, Pa.

Former Governor HAROLD G. HOFFMAN of New Jersey.

HARVEY P. JONES, Plant Supt., Jordanville Limestone Quarry, General Crushed Stone Co., Jordanville, Herkimer County, N. Y.

W. M. LUNAN, Plant Superintendent, Auburn Limestone Quarry, General Crushed Stone Co., Auburn, Cayuga County, N. Y.

R. E. SANSOM, Mgr., Crushed Stone Operations, Holston Limestone Quarry, American Limestone Co., Mascot, Knox County, Tenn.

WINNERS 1949 NCSA SAFETY CONTEST

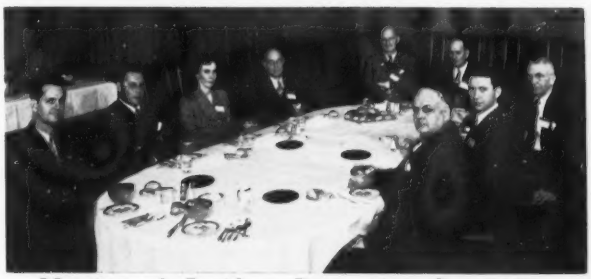
PLANT WINNER

MAN HOURS WITHOUT A LOST-TIME ACCIDENT	
171,474	HAGERSTOWN QUARRY, NORTH AMERICAN CEMENT CORP. HAGERSTOWN, WASHINGTON COUNTY, MARYLAND—ED. SLOTTERBECK, SUPT.

HONORABLE MENTION

171,207	LE ROY LIMESTONE QUARRY, the GENERAL CRUSHED STONE CO., LE ROY, GENESEE COUNTY, NEW YORK—MERLE PRICE, PLANT SUPT
143,374	CEDAR HOLLOW LIME QUARRY, WARNER COMPANY, DEVAULT, CHESTER COUNTY, PA.—JOHN MURDOCK, CHAIRMAN, PLANT SAFETY COMM.
125,080	BAKERTON LIMESTONE MINE, the STANDARD LIME & STONE CO., BAKERTON, JEFFERSON COUNTY, W. VA.— W. J. B. HOUSER, PLANT SUPT.
76,588	JORDANVILLE LIMESTONE QUARRY, the GENERAL CRUSHED STONE CO., JORDANVILLE, HERKIMER COUNTY, N.Y.—HARVEY P. JONES, PLANT SUPT.
74,116	ROCK HILL TRAP ROCK QUARRY, the GENERAL CRUSHED STONE CO., QUAKERTOWN, BUCKS COUNTY, PA.—EDGAR Z. COLE, PLANT SUPT.
73,066	WHITE HAVEN SANDSTONE QUARRY, the GENERAL CRUSHED STONE CO., WHITE HAVEN, LUZERNE COUNTY, PA.—BURR SHAVER, PLANT SUPT.
67,160	AUBURN LIMESTONE QUARRY, the GENERAL CRUSHED STONE CO., AUBURN, CAYUGA COUNTY, N.Y. —W. M. LUNAN, PLANT SUPT.
55,954	MIDDLEFIELD NO. 1 TRAP ROCK QUARRY, the NEW HAVEN TRAP ROCK CO., MIDDLEFIELD, NEW HAVEN COUNTY, CONN.—JOHN H. McKERNAN, PLANT SUPT.
53,775	PHILLIPSBURG LIMESTONE QUARRY, the LAURA GRAVEL & STONE CO., PHILLIPSBURG, MONTGOMERY COUNTY, OHIO—ROGER D. BAKER, SUPT.
52,454	MARTHA LIMESTONE QUARRY, MARQUETTE CEMENT MFG. CO., MARTHA, WILSON COUNTY, TENN.
51,631	HOLSTON LIMESTONE QUARRY, AMERICAN LIMESTONE CO., MASCOT, KNOX COUNTY, TENN. — JOHN NORTON, SUPT.
49,042	MARQUETTE LIMESTONE QUARRY, MARQUETTE CEMENT MFG. CO., CAPE GIRARDEAU, CAPE GIRARDEAU COUNTY, MO.
28,901	PLANT NO. 4 TRAP ROCK QUARRY, SOUTHWEST STONE CO., KNIPPA, UVALDE COUNTY, TEXAS — E. O. JONES, PLANT SUPT.
28,000	AMES AG LIME & ROAD STONE QUARRY, RAY COOK CONSTRUCTION CO., AMES, STORY COUNTY, IOWA — GEO. P. UPTON, PLANT SUPT.
27,480	BERKELEY LIMESTONE QUARRY, NORTH AMERICAN CEMENT CORP., MARTINSBURG, BERKELEY COUNTY, W. VA. E. F. ALDERTON, SUPT.
20,000	N. R. GARRETT CITY ROAD & AGRICULTURAL STONE QUARRY. N. R. GARRETT CITY QUARRY CO., COLUMBIA, BOONE COUNTY, MISSOURI — J. T. JONES, SUPT.
14,560	RIPPLEMEAD HYDRATED LIME QUARRY, RIPPLEMEAD LIME CO., INC., RIPPLEMEAD, GILES COUNTY, VA. — RALPH E. HUFFMAN
4,000	LAMKE AGRICULTURAL LIME QUARRY, BRAMEL LIMESTONE QUARRY CO., WASHINGTON, FRANKLIN COUNTY, MISSOURI — W. I. BRAMEL

PRESENTATION OF NCSA SAFETY AWARDS
WEDNESDAY LUNCHEON - HALL OF MIRRORS



Meeting of Accident Prevention Committee

Manufacturers Division — National Crushed Stone Association

These associate members are morally and financially aiding the Association in its efforts to protect and advance the interests of the crushed stone industry. Please give them favorable consideration whenever possible.

Allis-Chalmers Mfg. Co.
Milwaukee 1, Wis.
Crushing, Screening, Washing, Grinding, Cement Machinery; Motors; Texrope Drives; Centrifugal Pumps; Tractors

American Cyanamid Co.
Explosives Department
2527 Oliver Bldg., Pittsburgh 22, Pa.
Explosives and Blasting Supplies

American Manganese Steel Division
American Brake Shoe Co.
109 North Wabash Ave., Chicago 2, Ill.
Manganese Steel Castings, Power Shovel Dippers, Material Handling Pumps, Heat and Corrosion Resistant Castings, Reclamation and Hard-Facing Welding Materials

American Pulverizer Co.
1249 Macklind Ave., St. Louis 10, Mo.
Manufacturers of Ring Crushers and Hammermills for Primary and Secondary Crushing

American Steel & Wire Co.
Rockefeller Bldg., 614 Superior Ave., N. W., Cleveland 13, Ohio
Wire Rope, Aerial Wire Rope Tramways, Electrical Wires and Cables, Welded Wire Fabric, Concrete Reinforcing, Wire Nails, Fencing, Netting

Atlas Powder Co.
Wilmington 99, Del.
Industrial Explosives and Blasting Supplies

Austin-Western Co.
601 N. Farnsworth Ave., Aurora 1, Ill.
Jaw and Roll Crushers, Conveyors, Feeders, Screens, and Bins—Separately or Combined in Complete Crushing, Screening and Washing Plants; All Types of Dump, Hopper, and Quarry Cars, Air and Electrically Operated, in Narrow and Standard Gauges; Power Shovels, Drag Lines, and Cranes; Road Making, Earth Handling, and Street Cleaning Equipment

Bacon-Greene & Milroy
205 Church St., New Haven 10, Conn.
"FARREL-BACON" Jaw Crushers for Primary and Secondary Operations, Conveyors, Elevators, Rolls, Screens

Bacon-Pietsch Co., Inc.
149 Broadway, New York 6, N. Y.
Manufacturers of Farrel-Bacon Crushers and Allied Screening and Conveying Equipment

Baldwin-Lima-Hamilton Corp.
Lima-Hamilton Division
South Main St., Lima, Ohio
Power Shovels, Draglines and Cranes

Barber-Greene Co.
631 West Park Ave., Aurora, Ill.
Portable and Permanent Belt Conveyors, Belt Conveyor Idlers, Bucket Loaders both Wheel and Crawler Mounted, Asphalt Mixers and Finishers, Coal Handling Machines

Buchanan, C. G., Crushing Machinery Division of the Birdsboro Steel Foundry and Machine Co.
1941 Furnace St., Birdsboro, Pa.
Primary, Secondary, and Finishing Crushers and Rolls

Bucyrus-Erie Co.
South Milwaukee, Wis.
Excavating, Drilling and Material Handling Equipment

Caterpillar Tractor Co.
Peoria 8, Ill.
Track-Type Tractors, Bulldozers, Earthmoving Scrapers, Motor Graders, Heavy-Duty Off-Road Hauling Units, Diesel Engines, and Diesel Electric Generating Sets

Chain Belt Co.
1600 W. Bruce St., Milwaukee 11, Wis.
Rex Conveyors, Elevators, Feeders, Idlers; Drive and Conveyor Chains, Power Transmission Equipment; Concrete Mixers, Pavers, Pumpcrete and Portable Pumps

Cincinnati Rubber Mfg. Co.
4900 Franklin Ave., Cincinnati 12, Ohio
Conveyor and Elevator Belting, Flat Transmission Belting, Chute Lining, All Types of Hose

Construction Equipment
205 East 42nd St., New York 17, N. Y.
"The Equipment Application Magazine"

Continental Gin Co.
Industrial Division
4500 Fifth Ave., S., Birmingham 2, Ala.
Conveyors—Belt, Screw, Flight, and Underground Mine; Elevators—Bucket and Screw; Feeders—Apron, Belt, Reciprocating, Table, and Screw; Drives—V-Belts, Chains and Sprockets, Gears and Speed Reducers

Cross Engineering Co.
P. O. Box 16, Carbondale, Pa.
Screen Plates and Sections, Perforated Plate for Vibrating, Rotary and Shaking Screens

Cummins Engine Co., Inc.
Fifth and Union Sts., Columbus, Ind.
Diesel Engines, Fuel Pumps

Manufacturers Division—National Crushed Stone Association
(continued)

Deister Machine Co.
1933 East Wayne St., Fort Wayne 4, Ind.
Deister Plat-O Vibrating Screen, Deister Compound Funnel Classifier

Detroit Diesel Engine Division
General Motors Corp.
13400 West Outer Drive, Detroit 28, Mich.
Light Weight, Compact 2 Cycle Diesel Engines and "Package Power" Units for All Classes of Service

Diamond Iron Works, Inc.
1728 N. Second St., Minneapolis 11, Minn.
Jaw and Roll Crushers; Vibrator, Revolving, and Scrubber Screens; Drag Washers; Bucket Elevators; Belt Conveyors; Bins; Apron and Plate Feeders; Portable Gravel and Rock Crushing, Screening, and Washing Plants; Stationary Crushing, Screening, and Washing Plants; Hammermills

Du Pont, E. I., de Nemours & Co., Inc.
Wilmington 98, Del.
Explosives and Blasting Accessories

Eagle Iron Works
129 Holcomb Ave., Des Moines 13, Iowa
Fine Material Screw Washers—Classifiers—Dehydrators; Coarse Material Screw and Log Washers—Dewaterers; Water Scalping and Fine Material Settling Tanks; and "Swintek" Screen Chain Cutter Dredging Ladders

Easton Car and Construction Co.
Easton, Pa.
Heavy-Duty Dump Body Trailers for Rock and Ore, Truck Bodies, and Quarry Cars; Overhead Hoists for Dumping Haulage Units; Electric Heaters for Tar, Asphalt or Bitumen

Ensign-Bickford Co.
Simsbury, Conn.
Primacord-Bickford Detonating Fuse and Safety Fuse

Euclid Road Machinery Co.
1361 Chardon Road, Cleveland 17, Ohio
Heavy-Duty Trucks and Dump Trailers for "Off-Highway" Hauls, Loaders for Earth Excavation

Even Spread Co.
P. O. Box 87, Owensville, Ohio
Power Spreaders and Attachments for Agricultural Lime and Fertilizer

Flexible Steel Lacing Co.
4607 Lexington St., Chicago 44, Ill.
Flexco HD Belt Fasteners, Alligator Belt Lacing, Flexco Hinged Belt Fasteners, Alligator Belt Cutters, Alligator Wide Belt Cutters, Alligator V Belt Fasteners, Flex V Belt Fasteners

Frog, Switch & Mfg. Co.
Carlisle, Pa.
Manganese Steel Department—Manufacturers of "Indian Brand" Manganese Steel Castings for Frogs, Switches, and Crossings, Jaw and Gyratory Crushers, Cement Mills, Mining Machinery, Etc., Steam Shovel Parts

General Electric Co.
1 River Road, Schenectady 5, N. Y.
Electric Motors, Controls, Locomotives, Coordinated Electric Drives for: Shovels, Drag Lines, Conveyors, Hoists, Cranes, Crushers, Screens, Etc.; Coordinated Power Generating and Distributing Systems Including Turbine Generators, Switchgear, Transformers, Cable, Cable Skids, Load Center Substations

Gill Rock Drill Co.
Lebanon, Pa.
Well Drill Tools and Supplies

Goodrich, B. F., Co.
500 South Main St., Akron 18, Ohio
Industrial Rubber Products — Flexible Bonded Edge Conveyor and Elevator Belting, Cord Conveyor Belting, Highflex and Cord Transmission Belting; Grommet V-Belts; Type 54 Air Hydraulic Control, Burst Proof Steam, Water, Suction and Other Hose; Armorite Chute Lining; Rubber and Koroseal Protective Clothing and Footwear; Tires and Tubes (Automobile, Truck, Off-the-Road, Industrial), Batteries

Goodyear Tire & Rubber Co., Inc.
Akron 16, Ohio
Airfoam; Mechanical Goods—Belting (Conveyor, Elevator, Transmission), Hose (Air Water, Steam, Suction, Miscellaneous), Chute Lining (Rubber); Rims (Truck and Tractor); Storage Batteries (Automobile, Truck, Tractor); Tires (Automobile, Truck, Off-the-Road); Tubes (Automobile, Truck, Off-the-Road, LifeGuard, Safety Tubes, Puncture Seal Tubes

Gruendler Crusher and Pulverizer Co.
2915 N. Market St., St. Louis 6, Mo.
Rock and Gravel Crushing and Screening Plants, Jaw Crushers, Roll Crushers, Hammermills, Lime Pulverizers

Gulf Oil Corp.
Gulf Refining Co.
Gulf Bldg., Pittsburgh 19, Pa.
Lubricating Oils, Greases, Gasoline and Diesel Fuels

Haiss, George, Mfg. Co., Inc., Division
Pettibone Mulliken Corp.
141st-144th on Park Ave., New York 51, N. Y.
Bucket Loaders, Buckets, Portable and Stationary Conveyors, Car Unloaders

Manufacturers Division—National Crushed Stone Association
(continued)

Harnischfeger Corp.
4400 W. National Ave., Milwaukee 14, Wis.
A complete line of Power Excavating Equipment, Overhead Cranes, Hoists, Smootharc Welders, Welding Rod, Motors and Generators, Diesel Engines

HarriSteel Products Co.
420 Lexington Ave., New York 17, N. Y.
Woven Wire Screen Cloth

Hayward Co.
50 Church Street, New York 7, N. Y.
Orange Peel Buckets, Clam Shell Buckets, Electric Motor Buckets, Automatic Take-up Reels

Heidenreich, E. Lee, Jr., Consulting Engineers
67 Second St., Newburgh, N. Y.
Plant Layout, Design, Supervision; Open Pit Quarry Surveys; Appraisals—Plant and Property

Hendrick Mfg. Co.
Carbondale, Pa.
Perforated Metal Screens, Perforated Plates for Vibrating, Shaking, and Revolving Screens; Elevator Buckets; Test Screens; Wedge Slot Screens; Open Steel Floor Grating

Hercules Powder Co.
Wilmington 99, Del.
Explosives and Blasting Supplies

Hetherington & Berner Inc.
701-745 Kentucky Ave., Indianapolis 7, Ind.
Asphalt Paving Machinery, Sand and Stone Dryers, Dust Collectors

Hewitt-Robins Incorporated
370 Lexington Ave., New York 17, N. Y.
Belt Conveyors (Belting and Machinery); Belt and Bucket Elevators; Car Shake-outs; Feeders; Industrial Hose; Screen Cloth; Sectional Conveyors; Skip Hoists; Stackers; Transmission Belting; Vibrating Conveyors, Feeders, and Screens; Design and Construction of Complete Plants

Illinois Powder Mfg. Co.
112 N. Fourth St., St. Louis 2, Mo.
Gold Medal Explosives

Ingersoll-Rand Co.
11 Broadway, New York 4, N. Y.
Rock Drills, Quarrymaster Drills, Jackbits, Bit Reconditioning Equipment, Portable and Stationery Air Compressors, Air Hoists, Slusher Hoists, Air Tools, Diesel Engines, Pumps

Insley Manufacturing Corp.
801 N. Olney St., Indianapolis 6, Ind.
Concrete Carts and Buckets, ½ Yd. Cranes and Shovels

Iowa Manufacturing Co.
916 16th St., N.E., Cedar Rapids, Iowa
Rock and Gravel Crushing, Screening, Conveying and Washing Plants, Hot and Cold Mix Asphalt Plants, Stabilizer Plants, KU-BIT Impact Breakers, Screens, Elevators, Conveyors, Portable and Stationary Equipment, Hammermills

Jaeger Machine Co.
550 W. Spring St., Columbus 16, Ohio
Portable and Stationary Air Compressors, Self-Priming Pumps, Truck Mixers, Concrete Mixers, Road Paving Machinery, Hoists and Towers

Jaite Co.
Jaite, Ohio
Multiwall Paper Bags, Sewn and Pasted Style for Packaging Lime, Cement, Plaster, Etc.

Jeffrey Manufacturing Co.
E. First Ave., Columbus 16, Ohio
Material Handling Machinery, Crushers, Pulverizers, Screens, Chains

Joy Manufacturing Co.
333 Henry W. Oliver Bldg., Pittsburgh 22, Pa.
Drills: Blast-Hole, Wagon, Rock, and Core; Air Compressors: Portable, Stationary, and Semi-Portable; Aftercoolers; Portable Blowers; Carpullers; Hoists; Multi-Purpose and Portable Rock Loaders; Air Motors; Trench Diggers; Belt Conveyors; Drill-Bit Furnaces; "Spaders"; "String-a-Lite" (Safety-Lighting-Cable); Backfill Tampers; Drill Bits: Rock and Core

Kennedy-Van Saun Mfg. and Eng. Corp.
2 Park Ave., New York 16, N. Y.
Crushing, Screening, Washing, Conveying, Elevating, Grinding, Complete Cement Plants, Complete Lime Plants, Complete Lightweight Aggregate Plants, Synchronous Motors, Air Activated Containers for Transportation of Pulverized Material, Cement Pumps, and Power Plant Equipment

Kensington Steel Co.
505 Kensington Ave., Chicago 28, Ill.
Manganese Steel Castings, Dipper Teeth, Crawler Treads, Jaw Plates, Concaves and Hammers

Keystone Driller Co.
2001-2021 Eighth Ave., Beaver Falls, Pa.
Drills, Power Shovels

King Powder Co., Inc.
Cincinnati, Ohio
Detonite, Dynamites, and Blasting Supplies

Koehring Co.
3026 W. Concordia Ave., Milwaukee 16, Wis.
Excavating, Hauling and Concrete Equipment

Manufacturers Division—National Crushed Stone Association
(continued)

Kraft Bag Corp.
630 Fifth Ave., New York 20, N. Y.
Heavy Duty Multiwall Paper Bags

Link-Belt Co.
300 West Pershing Road, Chicago 9, Ill.
Complete Stone Preparation Plants; Conveyors, Elevators, Screens, Washing Equipment, Speed-O-Matic Shovels—Cranes—Draglines and Power Transmission Equipment

Ludlow-Saylor Wire Co.
634 S. Newstead Ave., St. Louis 10, Mo.
Woven Wire Screens and Wire Cloth of Super-Loy, All Commercial Alloys and Metals

Mack Manufacturing Corp.
350 Fifth Ave., New York 1, N. Y.
On- and Off-Highway Trucks, Tractor Trailers, Six-Wheelers, from 5 to 30 Tons Capacity, both Gasoline- and Diesel-Powered

Marion Power Shovel Co.
617 W. Center St., Marion, Ohio
A Complete Line of Power Shovels, Draglines, and Cranes

Marsh, E. F., Engineering Co.
4324 W. Clayton Ave., St. Louis 10, Mo.
Plant Design, Engineering Service, Complete Pit and Quarry Equipment

McLanahan & Stone Corp.
200 Wall St., Hollidaysburg, Pa.
Complete Pit, Mine, and Quarry Equipment —Crushers, Washers, Screens, Feeders, etc.

Michigan Power Shovel Co.
270 Miller St., Benton Harbor, Mich.
Truck Mounted and Crawler Shovel Crane 3/8 and 1/2 Cu. Yd.

Murphy Diesel Co.
5317 W. Burnham St., Milwaukee 14, Wis.
Murphy Diesel Engines Ranging from 90 to 190 Continuous Horsepower at 1200 Rpm. and Packaged Type Generator Sets 60 to 133 Kw. for All Classes of Service

Nelson, N. P., Iron Works, Inc.
820 Bloomfield Ave., Clifton, N. J.
Nelson Bucket Loaders

Nordberg Mfg. Co.
3073 S. Chase Ave., Milwaukee 7, Wis.
Cone, Gyratory, Jaw and Impact Crushers; Grinding Mills; Stone Plant and Cement Mill Machinery; Vibrating Screens; Grizzlies; Diesel and Steam Engines; Compressors; Mine Hoists; Track Maintenance Tools

Northern Blower Co.
6409 Barberton Ave., Cleveland 2, Ohio
Dust Collecting Systems, Fans—Exhaust and Blower

Northwest Engineering Co.
135 S. LaSalle St., Chicago 3, Ill.
Shovels, Cranes, Draglines, Pullshovels

Osgood Co.
Cheney Ave., Marion, Ohio
Power Shovels, Cranes, Draglines, Hoes, Etc., 3/8 to 2 1/2 Cu. Yd.

Pennsylvania Crusher Co.
Liberty Trust Bldg., Broad and Arch Sts., Philadelphia 7, Pa.
Single Roll Crushers, Impactors, Hammermills, Ring Type Granulators, KUE-KEN Jaw Crushers, KUE-KEN Gyracones

Pettibone Mulliken Corp.
4710 W. Division St., Chicago 51, Ill.
Buckets, Dragline and Parts; Loaders—Car, Bucket; Plants—Asphalt, Portable

Pioneer Engineering Works, Inc.
1515 Central Ave., N. E., Minneapolis 13, Minn.
Jaw Crushers, Roll Crushers (Twin and Triple), Vibrating and Revolving Screens, Feeders (Mechanical, Grizzly, Apron, and Pioneer-Oro), Belt Conveyors, Portable and Stationary Crushing and Screening Plants, Washing Plants, Mining Equipment, Cement and Lime Equipment, Asphalt Plants

Pit and Quarry Publications
538 South Clark St., Chicago 5, Ill.
Pit and Quarry, Pit and Quarry Handbook, Pit and Quarry Directory, Concrete Manufacturer, Concrete Industries Yearbook

Quaker Rubber Corp.
Tacony and Milnor Sts., Philadelphia 24, Pa.
Conveyor Belts, Hose, and Packings

Rock Bit Sales and Service Co.
350 Depot St., Asheville, N. C.
Tungsten Carbide Detachable Bits, "Rock Bit" Drill Steel Inlaid with Tungsten Carbide, Carbon Hollow Drill Steel, Alloy Hollow Drill Steel

Rock Products
309 West Jackson Blvd., Chicago 6, Ill.

Manufacturers Division—National Crushed Stone Association
(concluded)

Roebling's, John A., Sons Co.
Woven Wire Fabrics Division
Roebling, N. J.
Aggregate Screen, Hardware and Industrial Wire Cloth, Insect Screening, Wire Rope, Fittings and Strand, Slings, Suspension Bridges and Cables, Aerial Wire Rope Systems, Ski Lifts, Electric Wire and Cable, Magnet Wire

Sanderson-Cyclone Drill Co.
South Main St., Orrville, Ohio
All Steel Wire Line, Air Speed Spudders, Large Blast Hole Drills, Drilling Tools and Drilling Supplies

Schield Bantam Co.
Waverly, Iowa
Bantam Trench Hoes, Draglines, Clams, Shovels

Screen Equipment Co.
1754 Walden Ave., Buffalo 21, N. Y.
SECO Vibrating Screens

Shaped Charge Explosive Manufacturers, Inc.
P. O. Box 900, Martinsburg, W. Va.
Shaped Charge Explosives for Industrial Rock Reduction

Simplicity Engineering Co.
Durand, Mich.
Simplicity Gyrating Screen, Simplicity D'centegrator, Simplicity D'watering Wheel

Smith Engineering Works
532 E. Capitol Drive, Milwaukee 12, Wis.
Gyratory, Gyrasphere, Jaw and Roll Crushers, Vibrating and Rotary Screens, Gravel Washing and Sand Settling Equipment, Elevators and Conveyors, Feeders, Bin Gates, and Portable Crushing and Screening Plants

Stedman Foundry & Machine Works
Aurora, Ind.
Stedman Impact-Type Selective Reduction Crushers, 2-Stage Swing Hammer Limestone Pulverizers

Stephens-Adamson Mfg. Co.
Aurora, Ill.
Belt Conveyors, Elevators, Feeders, Car Pullers, Screens, Skip Hoists, Complete Plants

Talcott, W. O. & M. W., Inc.
91 Sabin St., Providence 1, R. I.
Belt Fasteners, Belt Lacing, Conveyor Belt Fasteners, and Patch Fasteners

Taylor-Wharton Iron & Steel Co.
High Bridge, N. J.
Manganese and other Special Alloy Steel Castings; Dipper Teeth, Fronts and Lips; Crawler Treads; Jaw and Cheek Plates; Mantles and Concaves; Pulverizer Hammers and Liners; Asphalt Mixer Liners and Tips; Manganese Nickel Steel Welding Rod and Plate

Thew Shovel Co.
East 28th St. and Fulton Rd., Lorain, Ohio
Power Shovels, Cranes, Crawler Cranes, Locomotive Cranes, Draglines, Diesel Electric, Gasoline, 3/8 to 2 1/2 Cu. Yd. Capacities

Torrington Co.
Bantam Bearings Division
3702 W. Sample St., South Bend 21, Ind.
Anti-Friction Bearings (All Types and Sizes)

Traylor Engineering & Mfg. Co.
Allentown, Pa.
Stone Crushing, Gravel, Lime, and Cement Machinery

Trojan Powder Co.
17 N. 7th St., Allentown, Pa.
Explosives and Blasting Supplies

Tyler, W. S., Co.
3615 Superior Ave., N. E., Cleveland 14, Ohio
Wire Screens, Screening Machinery, Scrubbers, Testing Sieves and Dryers

Universal Engineering Corp.
625 C Ave., N. W., Cedar Rapids, Iowa.
Jaw Crushers, Roll Crushers, Hammermills, Complete Crushing, Screening, and Loading Plants, Either Stationary or Portable for Stone Aggregates or Aglime

Vibration Measurement Engineers
7705 Sheridan Rd., Chicago 26, Ill.
Specialists in Blasting Complaint Investigations; Seismological Surveying; Expert Testimony in Blasting Litigation

Technical Publications
of the
National Crushed Stone Association

STONE BRIEFS

No. 1. How to Proportion Workable Concrete for Any Desired Compressive Strength

No. 2. How to Proportion Concrete for Pavements

No. 3. Uses for Stone Screenings

No. 4. How to Determine the Required Thickness of the Non-Rigid Type of Pavement for Highways and Airport Runways

No. 5. The Insulation Base Course Under Portland Cement Concrete Pavements

ENGINEERING BULLETINS

No. 1. The Bulking of Sand and Its Effect on Concrete

No. 2. Low Cost Improvement of Earth Roads with Crushed Stone

No. 3. The Water-Ratio Specification for Concrete and Its Limitations (Supply Exhausted)

No. 4. "Retreading" Our Highways

No. 5. Reprint of "Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey" with Discussion

No. 6. The Bituminous Macadam Pavement

No. 7. Investigations in the Proportioning of Concrete for Highways

No. 8. The Effect of Transportation Methods and Costs on the Crushed Stone, Sand and Gravel, and Slag Industries (Supply Exhausted)

No. 9. Tests for the Traffic Durability of Bituminous Pavements

No. 10. Stone Sand (Supply Exhausted)

No. 11. A Method of Proportioning Concrete for Strength, Workability, and Durability. (Revised January, 1949)

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Single copies of the above publications are available upon request.

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Manual of Uniform Cost Accounting Principles and Procedure for the Crushed Stone Industry (*$2.00 per copy*)